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NEEDED STAR-SURVEYS.

BY RICHARD A. PROCTOR.

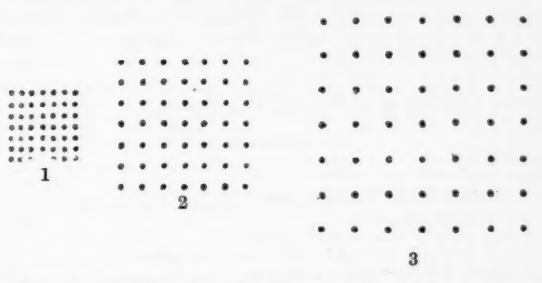
(*Continued from p.* 8.)

SIR JOHN HERSCHEL naturally rejected the idea that the features of the Magellanic Clouds are to be thus explained. Even if we could suppose, he said, that one of these clouds had the shape of a long cylinder whose axis was directed exactly towards our solar system, it would be impossible to suppose that the other is to be similarly interpreted, that a similar strange chance had set a second long cylinder of stars in space with its axis bearing exactly on the sun's family. He does not seem to notice the yet more fatal objection that each Magellanic Cloud would have to be something more than a cylinder of stars so situate: at an immense distance beyond each cylinder, and exactly in the prolongation of its axis, there would have to be a cloud of star-clouds, to account for the multitudinous nebulæ within the nubeculæ. But Sir John Herschel pointed out objections enough to convince every one that the Magellanic Clouds have in reality the rounded form which they appear to have. Then he went on to show that this being so, the distance of the remotest object in either nubecula does not exceed the distance of the nearest, by more than as ten exceeds nine: within these narrow limits of distance, he says, lie all orders of stars from the seventh down to the faintest visible in the great gauging telescope, nay even to milky light completely irresolvable into stars, besides all orders of nebulæ, clustering, irregular, round, elliptical, resolvable and irresolvable, bright and faint.

All this shows that science had been quite mistaken in supposing that the stellar universe consists merely of stars, not differing greatly in size, or much more richly strewn in some parts than in others. Just as the old idea of the solar system formed by Copernicus, as a central body circled round by six planets, has long since had to give way to the diversified system recognised by the astronomy of to-day, with its sun and giant planets, terrestrial planets and asteroids, large moons themselves as worlds and small moons like those of Mars, the ring system of Saturn, and finally (at present at least) the Cometic and Meteoric systems, so has the old and simple idea of the stellar galaxy had to give place to the conception of a most complex system, with giant suns, suns like our own, and minor suns, double, triple and multiple suns, clustering aggregations, streams, branches, clouds, and complex groupings of stars of all orders, with nebulæ of all kinds, stellar and gaseous, round, oval, ring-shaped, spiral, and irregular.

And here I would pause for a moment to correct an idea which has been very frequently suggested in terms implying that it is the obvious explanation of what we see instead of being absolutely inadmissible. In almost all works of astronomy, when the varying degree of resolvability within cloudlike regions of star space has been mentioned, we find the minute points of light recognised when resolution is effected, treated as if of necessity they were suns like our own, each girt round by its family of worlds But this is altogether incorrect. It is absolutely certain that stars strewn through space like our sun and his fellow-suns (the individual stars of our constellations), could never appear as a milky, unresolved nebulosity: for the simple reason that with increase of distance the individual stars, even were they as large as Sirius, would disappear long before they drew close enough together to present the appearance of irresolvable cloud. This is easily shown. Suppose the stars visible to the naked eye to be all suns like our own, the faintest being therefore about a hundred times farther away than the brightest. Then for that spherical region of space to be removed to so great a distance that the whole set of some 6,000 stars formed a cloud as large as the moon, the centre (our sun suppose) would have to be removed to a distance exceeding more than a hundredfold the entire diameter of the sphere, and therefore exceeding more than two hundredfold the distance of the faintest visible star from our solar system. All those 6,000 stars then would lie not only enormously beyond our unaided vision, but beyond the range of telescopes of considerable light-gathering power. For, removing the faintest, to a distance two hundred times greater would correspond to reducing its light to one-eight millionth part of its present amount. But six thousand stars strewn over such a portion of the heavens as the moon covers, would be easily separated: the average distance between them would be twenty seconds of arc, and double stars separated by such a distance as that are considered quite "coarse." Thus, long before the individual stars were merged into each other by the effect of distance, each would be separately undiscernible. Now it should hardly be necessary to point out that to speak of stars separately invisible, but lying at distances easily discernible (as such), forming a milky light, however faint, is utterly absurd. It is essential for the production of such milky light as we see in the galaxy, that the apparent distances of the separate stars should be lost through effect of distance before the stars cease to be visible.

As the point considered in the last paragraph is of great importance, and very little understood (or noticed, if understood), I give the following illustrative tests:—



Here we have three groups of dots all of the same size,

but less closely in 2 than in 1, and still less closely set in 3. Now if the page be set up where the light falls well upon it, and then the observer retreat gradually from it, he will find that at a certain distance 1 assumes the appearance of a darkish grey square, while the separate spots in 2 and 3 remain still visible. Farther away 1 remains as a darkish grey square, of just the same tint as before, but smaller; 2 appears as a light grey square, and the separate spots of 3 are scarcely discernible. But passing farther away the separate spots in 3 disappear altogether from view without having coalesced, as those of 1 and 2 successively did, so as to form a tint. When last seen they are still at recognisable distance from each other. Moreover the tints of 1 and 2 remain unchanged as you pass farther away. All that happens with these squares is that they appear to become smaller with increase of distance.

These illustrative tests show that the mere visibility of milky nebulosity in the star-depths tells something about the distribution and nature of the stars within the region observed. Stars separated by considerable distances can never appear like a diffused cloud. Stars of the same size, but somewhat more closely set, will appear as a very faint nebulosity if far enough away; if still more closely set, such stars will appear as a brighter nebulosity, even when at a more moderate distance; and a number of such stars very closely set indeed will appear as a very bright nebulosity even at a small (relative) distance. But wheresoever set beyond the distance at which nebulosity results, a star-cluster will appear neither brighter nor fainter, only larger when nearer and smaller when farther away.

Thus when we see a bright milky nebulosity in a rounded region (the shape showing that we have not to do with enormously long ranges of stars in the direction of the line of sight), we know that we have before us closely-set stars, not stars strewn like those which form our constellations. We know that the stars in Cassiopeia for instance could never form a nebulous group such as the Pleiades appears to weak eyesight, or the beautiful cluster in the sword-hand of Perseus to the keenest vision. For we know that long before the stars in Cassiopeia had approached near enough to each other,—through the recession of the group,—to coalesce, they would have disappeared wholly from view. Nor would any further increase of distance and the use of the telescope make any difference: the telescope would increase the brightness of the stars themselves as it increased the apparent distance between them; and at whatever distance the stars disappeared to telescopic vision they would still be as far from coalescing as when similarly disappearing to ordinary vision.* So that the group of stars forming the Pleiades is altogether differently arranged from the group of as many stars forming Cassiopeia; the group forming the Beehive (Præsepe in Cancer) is again differently arranged, the group in Perseus differently arranged still; and in fine each star-grouping is unlike its fellows, just as the family of giant planets is unlike the family of terrestrial planets, and that family again unlike the zone of asteroids. The arrangements of stars are as varied as are the stars themselves unlike in size and glory: the architecture of the stellar universe is as diverse as its materials.

(To be continued.)

* Perhaps I should rather say to ordinary vision corrected by a glass just making the stars neat and well defined; for there is not one man in a thousand whose view of a star group is not to some degree improved by the use of an eye-glass just adapted to correct the defects of his vision—defects scarcely noticeable otherwise.

THE WORKSHOP AT HOME.

By a Working Man.

(Continued from p. 480 of Vol. VI.).

OUR last piece of work was a set of bookshelves. I now propose to show how to construct an equally useful piece of furniture (if that is the right way of describing it): I mean a kind of wardrobe cupboard in a bedroom recess. Fig. 33 is a plan of our recess—*i.e.*, a

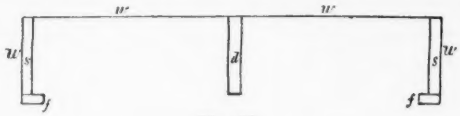


Fig. 33.

view of its shape as it would be presented to an eye in the ceiling over it. I will suppose it to be 4 ft. 6 in. in extreme width, and 1 ft. deep—common dimensions enough, and this we are going to fit up as shown in Fig. 34, which represents our cupboard with the doors and their

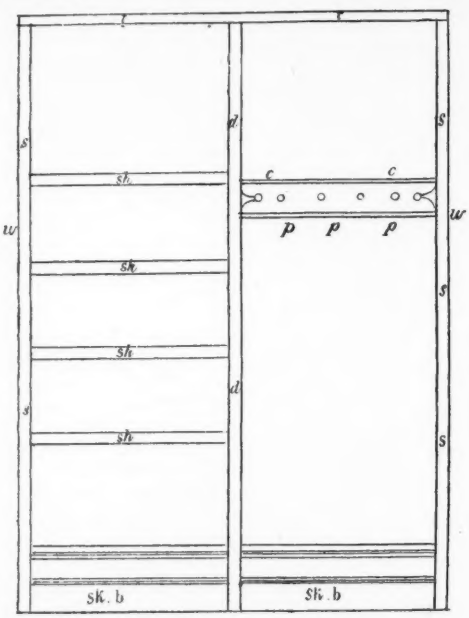


Fig. 34.

frame removed. These figures are drawn to the scale of half an inch to the foot, whence anyone, by the aid of a divided rule, may see that the whole enclosure is to be seven feet high. Of this we shall only utilise 6 ft. 1 in., the remaining 11 in. being occupied by a more or less ornamental top. Now, we will use the wall itself in the recess for the back of our cupboard; but to the wall, on each side above the skirting-board, must be securely nailed pieces of board, *s s*, 10½ in. wide, 1 in. thick, and of sufficient length to make up, with the thickness of 1 in. board, *t t*, the entire height of 7 ft. from the ground. Half-way between these side pieces a piece of 1½ in. board, *d*, must be fixed, acting at once as a partition to divide the cupboard, and a stop, against the front edge of which the closed doors will abut, and into which a very simple form of bolt to hold them may be fastened. The reader by this time will not need any instruction in the art of sawing-out the planking, planing

it up true, and, if necessary, joining two boards edge to edge to form one of the required width, this last operation, of course, being performed before the board is finally "trued up." In fastening the side boards, *s s*, to the wall, of course, all we had to do was to see that they were of the proper height, width, and thickness, and to nail them to the wall itself; but, in the case of the division, *d*, we shall have a little more trouble in fixing it, because, as will be at once seen, it stands edgeways to the wall. First we must cut out the shape of the skirting-board (*Sk b*, Fig. 34) from the back and bottom of our 6 ft. 11 in. plank, until the hinder edge fits flat against the wall, *w*, *w*. A screw must pass through the front edge diagonally into the floor (see B, Fig. 30, p. 480, of Vol. VI. of KNOWLEDGE), while three stout clasp nails driven through the top board, *t*, into the upper edge of *d*, will make it all secure. The ends of this top board must, of course, be secured to the side boards, *s*, *s*, in a similar manner. The four shelves, of 1-in. planking, 10½ in. wide (*sh*, *sh*, Fig. 34) are to be fitted in precisely as were the bookshelves, whose manufacture I described on p. 479 of the last volume. The space beneath them and the floor is handy for boots, &c. In the right hand compartment, we nail round three sides of it the board *c*, *c*, 5 in. wide, into which are glued the pegs, *p*, *p*, *p*, for hanging clothes on. As I am supposing that the amateur is not yet in possession of a lathe, he will have to buy these pegs; but their cost is very small indeed at any turner's. It will be noted that the boards, *c*, *c*, must be

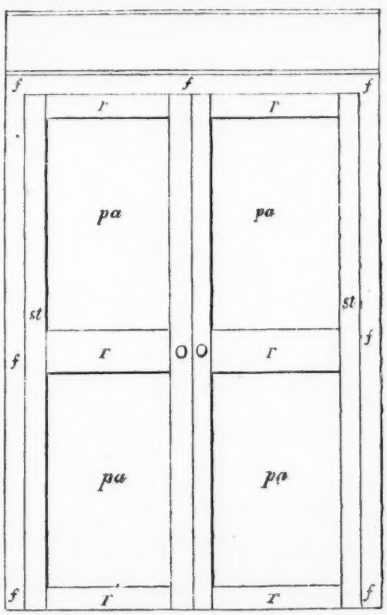


Fig. 35.

"mitred" at the ends where they meet. So far, we have filled our recess with shelves and pegs, but have, of course, left the whole thing open to the room. We want, though, to make a cupboard of it, and to this end must fit it with two doors. Before reading what is about to follow, I recommend the amateur carpenter to turn back to p. 155 of the VIth Volume of this paper, and refresh his memory by a careful study of the directions for making the frame of a screen, because we shall, to a considerable extent, repeat what we did in that case. The frame, *f*, *f* (Figs. 33, 34, and 35) is of 1½-in. stuff when planed up, and is 3 in. wide. It is tenoned and morticed together at its two upper corners, and is screwed to the edges of the boards, *s s*. Obviously, these (like *d*) will have to be accurately cut out at their back bottom edges to fit over the skirting-board, and, like *d*, should be firmly attached to the floor, too, through their front bottom edges, by diagonally-inserted screws. These must be carefully countersunk, or we shall not be able to hang our doors. It will be observed that the outside measurement of this frame is 6 ft. 2 in. by 4 ft. 6 in.; its inside measurement 5 ft. 11 in. by 4 ft. This last evidently represents the *outside* dimensions of the space immediately to be filled by the pair of doors, which we now proceed to make.

The making of this pair of doors differs in one or two respects from the construction of the screen-frame on pp. 155 and 156 of the last volume, and it is to elucidate the difference that I have drawn Fig. 36. The three previous ones are all, as I have previously said, drawn to scale. Fig. 36 is neither drawn to scale nor in perspective, but as I can show the way in which a door is put together better in this way than by any perspective view, and as my object is to teach amateurs, and not to produce pretty or artistic pictures, it must stand as it is. The "stiles" and "rails" (*st* and *r* Fig. 36) are of 1½-in. stuff, the

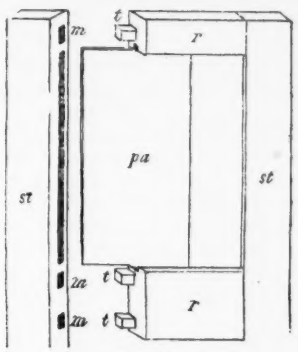


Fig. 36.

panels (*pa*) of ½-in. deal. The tenons *t t* on the rails are cut as usual, about two-thirds of the width of the wood and one-third of its thickness. One tenon only is needed at each end of the top and bottom rails, which are 3 in. wide, like the stiles; but the middle rails, which are 6 in. wide, will need two tenons, as I have shown above, the corresponding mortices being cut in the stiles. Before putting the stiles and rails together, a groove must be planed or cut on the *inside* of each, as shown in the figures into which the panel fits like a school-slate into its frame. The back edges of the panels are sloped or bevelled off in order that they may fit easily into the groove. The sketch shows the rails morticed into the right-hand stile, and a panel partly slid into its grooves, the left hand stile with its mortice-holes and long panel-groove, and the left-hand ends of the two rails being not yet put together. Everything being in readiness, the tenons and mortices are well brushed with thin, boiling-hot glue, and then the tenons are driven home as rapidly as may be, being, if needful, slightly wedged from the outside, where the fit is not very tight. When the glue is thoroughly dry, the plane should be run lightly and carefully over the outside edge of the frame. The hardest job, by far, that the amateur has yet attempted, he will find on the hanging of his two doors, for which he will require two pairs of "butt" hinges, with the necessary screws. The reader is recommended to study very carefully the hanging of any door in his own house, and to remember that the doors he has just finished are to open

outwards into the bedroom. A little examination of the way in which the flat plates of the butt are countersunk into the frame and the door-stile respectively, will teach him more than a page of description. A couple of cupboard handles with a small flat bolt may be easily fixed by the aid of the centre-bit and a firmer chisel. Finally, a piece of planking 4 ft. 6 in. long, 9 in. wide, and ½ in. thick may be nailed on to cover the gap between the top of the door-frame and the top of the cupboard (*tt*, Fig. 34), this may be moulded as recommended for the upper part of the bookshelves, whose construction I described in Vol. VI., p. 479, and finally the whole structure should be painted to match the rest of the room.

CHATS ON GEOMETRICAL MEASUREMENT.

(*Continued from p.* 11.)

By Richard A. Proctor.

THE HYPERBOLA.

A. I do not feel quite satisfied yet, with regard to the conic sections. We have done very little with the hyperbola. Can you not show how it is to be dealt with geometrically?

M. I would not trouble about it if I were you. You will not regard the result, or much of the work as geometrical.

A. Still, I should like to have an idea of its nature. The area of the parabola came out so neatly, that I want to see why the hyperbola cannot be conveniently dealt with.

M. I have no objection. Let K A K′ (Fig. 1) be a rectangular hyperbola; C its centre; C A L its axis; C A, C B its semi-diameters; and C N, C N′ the asymptotes. I suppose what you want is to determine the area of such a space as A P K L, where K L is drawn perpendicular to the axis?

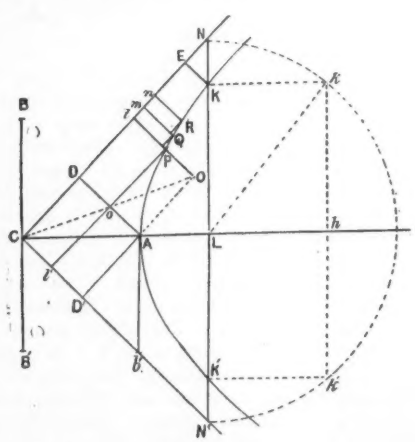


Fig. 1.

A. That was what we did with the parabola.

M. Note first, then, that drawing N K K′ N′ as in the figure, C A, A L being given lengths, K L and N K are known. For N K . K N′=sq. on A *b*′ or B C. Thus, if, on N N′, a semicircle N *k* N′ is described, and L *h* being taken equal to A *b*′, *k h k*′ is drawn parallel to N N′, then *k* K, *k* K′ perp. to N N′, give points K and K′ on the hyperbola; and K L is thus seen to be equal to a side of a right-angled triangle L K *k*, whose hypothenuse is equal to L N (or C L) its other side to B C or C A. Thus, in what follows we may deal with N K, K L as assigned lengths. (We note also in passing a way of obtaining any number of points on the hyperbola by the simple geometrical construction just indicated.)

A. And now, can we determine the area A P K L?

M. Not directly. For the lengths corresponding to K L are not so simply related to A C as to make a series of thin rectangles, perp. to C L, conveniently summable (if I may invent such a word).

A. How then are we to proceed?

M. The simplest rectangular relations of the hyperbola,—those, therefore, which seem most likely to suit our purpose,—belong to the space between the hyperbola and its asymptotes. As you know, if from P, P *l* and P *l*′ are drawn perp. to the asymptotes, the rectangle P *l* C *l*′ is constant, and equal to the square A D C D′. (This, by the way, gives another and a still more convenient way of obtaining points on the hyperbola: thus draw any straight line C *o* O cutting D A in *o*, and D′ A, produced, in O; then O *l* parallel to C N′, meets *l*′ *o* parallel to C N, produced, in P, a point on the hyperbola. For the parallelograms *l l*′ and D D′ are equal, since *l o* and *o* D′ are complementary.)

A. Do you think it is well to go off on these side tracks?

M. For me the chief charm of mathematics resides in side views; and we are not in such a hurry, here, that we need always "'ammer, 'ammer, 'ammer along the 'ard 'igh road." To return to the main track, however,—suppose we deal with such an area as P *l* E K, obtained by drawing perps. P *l* and K E to C N. Now, if we try drawing Q *m*, R *n*, and so on, perp. to C N, at equal distances from each other, we shall find we make no progress; for the rectangles Q *l*, R *m*, &c., are not conveniently proportioned to each other, or to any other set of rectangles, as in the case of the ellipse and parabola. Suppose, then, we try, next, such an arrangement that the rectangles Q *l*, R *m*, &c., shall all be equal. In this case we have

$$\begin{aligned} l m : m n &:: \mathrm{R}n : \mathrm{Q}\mathrm{M} \\ &:: \mathrm{C}m : \mathrm{C}n \quad (\text{since } \mathrm{C}m \,.\, m\mathrm{Q} = \mathrm{C}n \,.\, n\mathrm{R}) \\ \therefore \quad \mathrm{C}l : \mathrm{C}m &:: \mathrm{C}m : \mathrm{C}n \\ \text{so that} \quad \mathrm{C}l : \mathrm{C}n &:: (\mathrm{C}l)^2 : (\mathrm{C}m)^2 \end{aligned}$$

A similar relation holding for all the points of division along *l* E, it follows that if there are *n* spaces like *l m*, *m n*, between *l* and E,—

$$\mathrm{C}l : \mathrm{C}\mathrm{E} :: (\mathrm{C}l)^n : (\mathrm{C}m)^n$$

or

$$\frac{\mathrm{C}\mathrm{E}}{\mathrm{C}l} = \left(\frac{\mathrm{C}m}{\mathrm{C}l}\right)^n ;$$

wherefore, taking logarithms——

A. Oh, come! I say, you know! These are geometrical chats, are they not?

M. And taking logarithms is not a geometrical process, you would imply?

A. Well, I think Euclid would have been rather surprised if you had asked him to take a logarithm.

M. We have arrived at a stage where we cannot help ourselves. Just as the area of the circle (and therefore that of the ellipse) can only be determined by arithmetical operations, so it is with the area of hyperbolic sections. Arithmetic is, however, very closely related to geometry. Observe, the relation we have just obtained, means that the length of C E bears to the length of C *l* (these lengths being expressed as numbers) is the same ratio which the *n*th power of the length of C *m* bears to the *n*th power of the length of C *m* (these lengths being also represented as numbers). Now what we want to determine, in reality, is the length C *m*, such that *n* spaces measured off from *l* on

the principle we have adopted (*i.e.*, all the rectangles like Q l, R m, equal) shall bring us to E. We have found an arithmetical relation which *happens* to serve our purpose, because we *happen* to have desired and utilised the arithmetical function known as a logarithm: if we decline to avail ourselves of this knowledge, we can go no further.

A. Let us do so, then, by all means. After all, it was I who invited you to the task.

M. Taking logarithms, then, we have (using Neperian or natural logarithms),—

$$\log \frac{CE}{C\,l} = n \log \frac{C\,m}{C\,l}$$

$$= n \log \left(1 + \frac{l\,m}{C\,l}\right)$$

$$= n \left\{ \frac{l\,m}{C\,l} - \frac{1}{2}\left(\frac{l\,m}{C\,l}\right)^2 + \frac{1}{3}\left(\frac{l\,m}{C\,l}\right)^3 + \text{\&c.} \right\}$$

wherefore, when n is very large, so that $l\,m$ is very small, and all the terms but the first in the above series may be neglected compared with the first,

$$n = \frac{C\,l}{l\,m} \cdot \log \frac{CE}{C\,l}$$

Now we have divided the space P l E K into n rectangles, each equal to Q m . $m\,l$, or to P l . $l\,m$ (it is the same thing when n is very large). Hence we have, when n is very large,

sum of rectangles in P l E K = n . P l . $l\,m$; or

$$\text{area P } l \text{ E K} = C\,l \text{ . P } l \text{ . } \log \frac{CE}{C\,l} = \text{square D D' . } \log \left(\frac{CE}{C\,l}\right);$$

$$\text{area A D E K} = \text{square D D' . } \log \left(\frac{CE}{CD}\right); \text{ and}$$

$$\text{area A P K L} = \tfrac{1}{2} (\text{sq. on C L} - \text{sq. on C D} - \text{sq. on E N}) - \text{sq. D D'. } \log \frac{CE}{CD}$$

A. Can the oblique hyperbola be similarly dealt with?

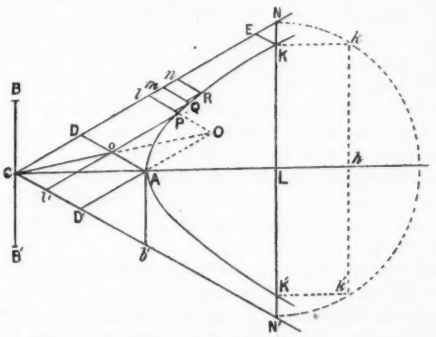


Fig. 2.

M. Quite easily. I recommend you to go through the reasoning for yourself, using Fig. 2 instead of Fig. 1, and making such changes as the oblique hyperbola requires and the figure suggests. You will obtain the following results:—

$$\text{Area P } l \text{ E K} = \text{rhombus D D' . } \log \left(\frac{CE}{C\,l}\right);$$

$$\text{area A D E K} = \text{rhombus D D' . } \log \left(\frac{CE}{CD}\right); \text{ and}$$

$$\text{area A P K L} = \triangle \text{C L N} - \triangle \text{C D A} - \triangle \text{N E K} - \text{rhombus D D' } \log \left(\frac{CE}{CD}\right).$$

(To be continued.)

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

LI.—MALTOSE AS A COOKING AGENT.

A FEW years ago the "farmer's friends" were very sanguine on the subject of using malt as a cattle food, and at agricultural meetings throughout the country the iniquitous malt tax was eloquently denounced because it stood in the way of the great fodder reform. The malt-tax was repealed, and the subject fell out of sight and hearing immediately thereafter. Why was this?

The idea of malt feeding was theoretically sound. By the malting of barley or other grain its diastase is made to act upon its insoluble starch, and to convert it more or less completely into soluble dextrin, a change which is absolutely necessary as a part of the business of digestion. Therefore, if you feed cattle on malted grain instead of raw grain, you supply them with a food so prepared that a part of the business of digestion is already done for them, and their nutrition is thereby advanced.

From what I am able to learn, the reason why this hopeful theory has not been carried out is simply that it does not "pay." The advantage to the cattle is not sufficient to remunerate the farmer for the extra cost of the malted food.

This may be the case with oxen, but it does not follow that it should be so with human beings. Cattle feed on grass, mangold-wurzels, &c., in their raw state, but we cannot; and, as I have already shown, we are not even graminivorous as they are—we cannot digest raw wheat, barley, oats, or maize.

We cannot do this because we are not supplied with such natural grinding apparatus as they have in their mouths, and we have a much smaller supply of saliva, besides a shorter alimentary canal.

We can easily supply our natural deficiencies in the matter of grinding, and do so in our flour-mills; but at first thought the idea of finding an artificial substitute for saliva does not recommend itself. When, however, it is understood that the chief active principle of the saliva so closely resembles the diastase of grain, that it has received the name of animal diastase, and is probably the same compound, the aspect of the problem changes.

Not only is this the case with the secretion from the glands surrounding the mouth, but the pancreas, which is concerned in a later stage of digestion, is a gland so similar to the salivary glands, that in ordinary cookery both are dressed and served as "sweetbreads," and its secretion, the pancreatic juice, is a liquid closely resembling saliva and containing a similar diastase, or substance that converts starch into dextrine, and from dextrine to sugar. Lehmann says "it is now indubitably established that the pancreatic juice possesses this sugar-forming power in a far higher degree than the saliva." Besides this there is another sugar-forming secretion, the "intestinal juice," which assists the graminivorous animals in the digestion of raw grain. This being the case, we should, by exercising our privilege as cooking animals, be able to assist the digestive functions of the saliva and the pancreatic and intestinal secretion, just as we help our teeth in the flour-mill; the means of doing this is offered by the diastase of malt.

In accordance with this reasoning I have made some experiments on a variety of our common vegetable foods, by simply raising them (in contact with water) to the temperature most favourable to the converting action of diastase (140° to 150° Fahr.), and then adding a little malt extract or malt flour. This extract may be purchased ready made or may be prepared by soaking crushed or ground malt in

warm water, leaving it for an hour or two, or longer, and then pressing out the liquid.

I find that oatmeal porridge, when thus treated with malt or malt extract, is thinned by the conversion of the bulk of its insoluble starch into soluble dextrine; that boiled rice is similarly thinned; that a stiff jelly of arrowroot is at once rendered watery, and its conversion into dextrine is demonstrated by its altered action on a solution of iodine. Instead of instantly striking a blue-black colour on admixture, only a slight brownish tinge is displayed, and not even this when the temperature has been carefully maintained.

Sago and tapioca are similarly changed, but not so completely as arrowroot. This is evidently because they contain a little nitrogenous matter and cellulose, which, when stirred, give a milkiness to the otherwise clear and limpid solution of dextrine.

Pease-pudding when thus treated behaves very instructively. Instead of remaining as a fairly uniform paste, it partially separates into paste and clear liquid, the paste being the cellulose and vegetable casein, the liquid a solution of the dextrine or converted starch. Turnips, carrots, potatoes, &c., behave similarly, the general results showing that, so far as the starch is concerned, there is no practical difficulty in obtaining a practically sufficient amount of conversion of the starch into dextrine by means of a very small quantity of maltose.

"Hasty pudding," made of boiled flour, is similarly altered; generally speaking, the degree of visible alterations is proportionate to the amount of starch, but the smaller the proportion and the greater that of cellulose, the more slowly the change occurs.

I have made a malt porridge by using ground malt, from which I sifted out as much husk as possible, instead of oatmeal. I found it rather too sweet; but, on mixing about one part of malt flour with four or more of oatmeal, an excellent and easily-digestible porridge was obtained, and one which I strongly recommend as a most valuable food for strong people and invalids, children and adults.

Further details of these experiments would be tedious, and are not necessary, as they display no chemical changes that are new to science, and the practical results may be briefly stated without such details.

I recommend, 1st, the production of malt flour by grinding and sifting malted wheat, malted barley, or malted oats, or all of these, and the retailing of this *at its fair value* as a staple article of human food. Every shopkeeper who sells flour or meal of any kind should sell this.

2nd. That this malted flour, or the extract made from it as above described, be mixed with the ordinary flour used in making pastry, biscuits, bread, &c.,* and with all kinds of porridge, pea-soup, and other farinaceous preparations, and that when these are cooked they should be slowly heated at first, in order that the maltose may act upon the starch at its most favourable temperature—50 or 60 degrees below the boiling-point.

3rd. When practicable, such preparations as porridge, pastry, pea-soup, pease-pudding, &c, should be prepared by first cooking them in the usual manner, then stirring the malt meal or malt extract into them, and allowing them to remain for some time. This time may vary from a few hours to several days—the longer the better. I have proved by experiments on boiled rice, oatmeal porridge, pease pudding, &c, that complete conversion may thus be effected. When the temperature of 140 deg. to 150 deg. is carefully obtained, the work of conversion is done in half-an-hour or less. At 212 deg. it is arrested. At temperatures below 140 deg. it proceeds with a slowness varying with the depression of temperature. The most rapid result is obtained by first cooking the food as usual, then reducing its temperature to 150 deg., and adding the malt flour or extract, and keeping up the temperature for a short time.

4th. Besides the malt meal or malt flour, which I presume will be preferably made from barley, I recommend the manufacture of what I may call "pearl malt," that is, malt treated as barley is treated in the manufacture of pearl barley. This pearl malt may be very largely used in soups, puddings, and for other purposes evident to the practical cook. It may be found preferable to the malt flour or meal for some of the above-named purposes, especially for making a purée like Rumford's soup. I strongly recommend such a soup to vegetarians, *i.e.*, the Rumford soup, No. 1, already described, but with the admixture of a little pearl malt with the pearl barley (or malt meal failing the pearl malt).

A small proportion of malt flour, 1-20th for example, has a considerable effect, and if a fancy price is to be paid for it such a proportion may be used, but if it comes into sufficient demand to be subject to wholesome competition larger proportions up to one-fourth will be desirable.

In my experiments I used the malt extract in order to render the result visible, but this is not necessary in practice. Either the extract or the flour may be used, as may be convenient. In all cases time should be allowed for the conversion of the starch to take place before raising the temperature to 212°, keeping in view the principles above explained as regards the temperature and time required for conversion.

I have not yet met with any malted maize commercially prepared, but the experiments that I have made on a small scale show that it is a very desirable product. I name it here and now (Jan. 8, 1885) to prevent its becoming patented, as there are so many greedy people who rush to the Great Seal Office with any idea they may pick up, however trivial. Any previous publication of the invention is sufficient to frustrate the monopoly. The same applies to the other uses of malt that I have specified.

I am still unable to speak positively as to the efficiency of vegetable diastase in breaking up or effecting the hydration of cellulose and its conversion into sugar; but the following facts are promising:—

I treated sago, tapioca, and rice with the maltose as above, and found that at a temperature of 140° to 150° all the starch disappeared in about half-an-hour, as proved by the iodine test. Still the liquid was not clear, flocculi of cellulose, &c., were suspended in it.

I kept this on the top of a stove several days, the temperature of the liquid varying from 100° to 180°, while the fire was burning and falling to that of the atmosphere at night. The quantity of the insoluble suspended matter sensibly diminished, but it was not entirely removed.

This has led me to make further experiments, now in progress, on the ensilage of human food, with the aid of diastase. I am packing various kinds of vegetable food in small silos, adding to them varying proportions of malt flour or malt extract, and I hereby declare, for the benefit of would-be patentees, that this invention, whether worthless or otherwise, is mine, and cannot be secured by them, as I have witnesses of the date of this writing and copy thereof. I shall certainly not patent this, or any of the above inventions myself, and will prevent others from

* I have lately learned that a patent was secured some years ago for "malt bread," and that it is still obtainable from many bakers, who make under a licence from the patentee. The "revised formula" for this, which I have just obtained, says: Take of wheat meal, 6 pounds; wheat flour, 6 pounds; malt flour, 6 ounces; German yeast, 2 ounces; salt, 2 ounces; water sufficient. Make into dough (without first melting the malt), prove well, and bake in tins. Malt flour is also sold, but at fancy prices, absurdly beyond its just value.

interfering with their free use in the improvement and cheapening of our food supplies. I am also treating such vegetable food material with various acids for the same purpose, and make the same claim in reference to this.

When by these or other means we convert vegetable tissue into dextrine and sugar, as it is naturally converted in the ripening of a pear, and as it has been artificially converted in our laboratories, we shall extend our food supplies in an incalculable degree. Swedes, turnips, mangold-wurzels, &c., will become delicate diet for invalids, horse-beans better than beef; delicate biscuits and fancy pastry, as well as ordinary bread, will be produced from sawdust and wood-shavings, plus a little leguminous flour.

This may be done now. Long ago I converted an old pocket-handkerchief and part of an old shirt into sugar. Other chemists have done the like in their laboratories. It has yet to be done in the kitchen.

I should add that the sugar referred to in all the above is not cane-sugar, but the sugar corresponding to that in the grape and in honey. It is less sweet than cane or beet sugar, and a better food.

I now conclude this series with the expression of my firm conviction that the application of chemical science to cookery is capable of vastly extending and improving our food-supplies, and thereby of greatly increasing the numbers of prosperous human beings capable of living on the earth. This, however, demands a great deal of further experimental research.

I have done so little of this in proportion to my suggestions for further research that I fear my readers will liken these papers to those others found by Prince Hal in the pockets of Jack Falstaff, "Oh, monstrous! but one halfpennyworth of experimental bread to this intolerable deal of speculative sack!"

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING (*continued*).

"WE are now arrived at the centre, which is always the bottom or lowest place of what is round: if we go on we must ascend: we shall find Mercury, Venus, the Earth, the Moon, and all the planets we have already visited; the next is Mars, who affords nothing curious that I know of; his day is not quite an hour longer than ours, but his year is twice as long. He is a little less than the earth, and the sun seems not altogether so large and so bright to him, as it appears to us. But let us leave Mars, he is not worth our stay."

"But what a pretty thing is Jupiter, with his four moons, or yeomen of the guard! They are four little planets that turn round him, as our moon turns round us."

"But why," says she, interrupting me, "must there be planets to turn round other planets, that are no better than themselves. I should think it would be more regular and uniform, that all the planets, little and great, without any distinction, should have one and the same motion round the sun."

"Ah, Madam," said I, "if you knew what were Descartes's whirlpools or vortexes (whose name is terrible, but their idea pleasant) you would not talk as you do."

"Must my head" (says she, smiling) "turn round to comprehend 'em, or must I become a perfect fool to understand the mysteries of philosophy? Well, let the world say what it will, go on with your whirlpools."

"I will," said I; "and you shall see the whirlpools are worthy of these transports.

"That, then, which we call a whirlpool or vortex is a mass of matter whose parts are separated or detach'd one from another, yet have all one uniform motion; and at the same time every one is allow'd, or has a particular motion of its own, provided it follows the general motion. Thus a vortex of wind, or whirlpool, is an infinity of little particles of air, which turn round altogether, and involve whatever they meet with. You know the planets are borne up by the celestial matter, which is very subtile and active; so that this great mass, or ocean of celestial matter, which flows as far as from the sun to the fixed stars, turns round, and bears the planets along with it, making them all turn after the same manner round the sun, who possesses the center, but in a longer or a shorter time, according as they are farther or nearer in distance to it. There is not any planet next the sun, which does not turn, but he turns on himself, because he is just in the middle of this celestial matter; and you must know by the way, that were the earth in his place, it must turn on itself, as the sun does. This is the great vortex, of which the sun is lord; yet at the same time, the planets make little particular vortexes, in imitation of that of the sun. Each of them in turning round the sun, does at the same time turn round itself, and makes a certain quantity of celestial matter turn round it likewise, which is always prepar'd to follow the motion the planet gives it, provided it is not diverted from its general motion.; this then is the particular vortex of the planet, which pushes it as far as the strength of its motion reaches; and if by chance a lesser planet falls into the vortex of a greater planet, it is immediately borne away by the greater, and is indispensably forc'd to turn round it, tho' at the same the great planet, the little planet, and the vortex which encloses 'em, all turn round the sun. 'Twas thus at the beginning of the world, when we made the moon follow us, because she was within the reach of our vortex, and therefore wholly at our disposal. Jupiter was stronger, or more fortunate than we; he had four little planets in his neighbourhood, and he brought 'em all four under his subjection; and no doubt we, tho' a principal planet, had met the same fate, had we been within the sphere of his activity: he is ninety times bigger than the earth, and would certainly have swallowed us into his vortex; we had then been no more than a moon in his family, when now we have one to wait on us: so that, you see, the advantage of situation decides often all our good fortune."

"But pray," says she, "who can assure us we shall still continue as we do now? If we should be such fools as to go near Jupiter, or he so ambitious as to approach us, what will become of us? For if (as you say) the celestial matter is continually under this great motion, it must needs agitate the planets irregularly; sometimes drive 'em together, and sometimes separate 'em."

"Luck is all," said I; "we may win as well as lose; and who knows we might bring Mercury and Venus under our government? they are little planets, and cannot resist us. But in this particular, madam, we need neither hope nor fear; the planets keep within their own bounds, and are oblig'd (as formerly the kings of China were) not to undertake new conquests. Have you not seen when you put water and oil together, the oil swims a-top? and if to these two liquors, you add a very light liquor, the oil bears it up, and it will not sink to the water; but put an heavier liquor, of a just weight, and it will pass through the oil, which is too weak to sustain it, and

sink till it comes to the water, which is strong enough to bear it up: So that in this liquid composed of two liquors, which do not mingle, two bodies of an unequal weight will naturally assume two different places; the one will never ascend, the other will never descend. If we put still other liquors which do not mingle, and throw other bodies on them, it will be the same thing. Fancy then that the celestial matter, which fills this great vortex, has several resting-places one by another, whose weight are different, like that of oil, water, and other liquors; the planets too are of a different weight, and consequently every planet settles in that place which has a just strength to sustain and keep it equilibrate: so you see 'tis impossible it should ever go beyond."

"I very well apprehend," says she, "that these weights keep their stations regularly. Would to God our world were as well regulated, and every one among us knew their proper place. I am now in no fear of being over-run by Jupiter; and since he lets us alone in our vortex with our moon, I do not envy him the four which he has."

"Did you envy him," I reply'd, "you would do him wrong, for he has no more than what he has occasion for; at the distance he is from the sun, his moons receive and send him but a very weak light."*

"It is true, that as he turns upon himself in ten hours, his nights, by consequence, are but five hours long; so one would think there is no great occasion for four moons. But there are other things to be considered: Here under the Poles they have six months day, and six months night, because the Poles are the two extremities of the earth, the farthest remov'd from those places where the sun is over 'em in a perpendicular line. The moon seems to keep almost the same course as the sun; and if the inhabitants of the Pole see the sun during one-half of his course of a year, and during the other half do not see him at all; they see the moon likewise during one-half of her course of a month; that is, she appears to 'em fifteen days, but they do not see her during the other half. Jupiter's year is as much as twelve of ours; so that there must be two opposite extremities in the planet, where their night and their day are six years each. A night six years long is a little disconsolate, and 'tis for that reason, I suppose, they have four moons; that which (in regard to Jupiter) is uppermost, finisheth its course about him in seventeen days, the second in seven, the third in three days and a half, and the fourth in forty-two hours; and tho' they are so unfortunate as to have six years' night, yet their course being exactly divided into halves, they never pass above twenty-one hours, wherein they do not see at least the last moon, which is a great comfort to so tedious a darkness: so that be where you will, these four moons are sometimes the prettiest sight imaginable; sometimes they rise all four together,† and then separate according to the inequality of their course; sometimes they are all in their meridian, rang'd one above another; sometimes you see 'em at equal distances on the horizon; sometimes when two rise, the other two go down. Oh! how I should love to see this pleasant sport of eclipses! for there is not a day passes, but they eclipse the sun, or one another; and they are so accustomed to these eclipses in that planet, that they are certainly more of diversion than of fear."

(To be continued.)

* It is worthy of notice that many writers who have dealt with this point since Fontenelle's time, have failed to notice the point on which he here touches.—R. P.

† It is impossible that all the moons of Jupiter can rise, and be on the meridian at the same time. For the movements of the three inner ones are so related that when two are in conjunction the third is in opposition to them.—R. P.

ELECTRO-PLATING.

By W. Slingo.

XVII.

As indicated in the previous article, the recovery of the silver from the stripping solution is, from an economical point of view, necessary. A copious accumulation of crystals, observable on allowing the solution to cool down, is a sure sign that the solution has done its work. Warning is also given by more or less persistent slow working. Being satisfied that the solution is ready for de-silvering, it should be diluted with a quantity of cold water. A considerable proportion of the silver may then be precipitated in greyish crystals by the addition of a few pieces of zinc. Chemically the zinc displaces the silver from its solution. The whole of the silver is not easily separated by this process, but the addition of a small quantity of hydrochloric will complete the precipitation. The acid should be added so long as the characteristic white precipitate of chloride of silver is produced. The supernatant liquid is then decanted, and the precipitate washed several times in fresh water, the zinc remaining undissolved being removed during the washing. The precipitate, being next dried, is mixed with a little dry carbonate of potash, and heated in a crucible until the whole of the silver is separated and collects in a globule or button of fine metal.

By another process, the whole of the silver may be converted into the chloride by adding to the diluted stripping solution, a solution of common salt. The chloride of silver being precipitated, is washed well and dried, and then mixed with carbonate of potash, after which it is heated in a crucible, and the silver separated as before. This plan answers well.

Another plan, less commendable, is to place the article to be stripped in the electrolytic bath, and, using it as the anode or positive pole, to remove the silver by electrolysis. This method will almost inevitably cause the plating solution to be spoiled; but this trouble may be got over by using a separate bath for the purpose, and employing the end of a wire as the cathode upon which to deposit the silver. The passage of a strong current speedily strips the article of its coating, which may be collected in small granules as they fall from the wire.

Theoretically, a solution once made should last indefinitely, and with great care it may remain efficient for a very lengthy period. There are, however, some difficulties and troubles, to prevent which the greatest precautions are impotent, and for this reason, if for no other, the solution gradually loses its power or quality, the deposit becomes bad in colour, and is liable to strip when subjected to the polishing processes.

Amongst the causes producing a deterioration of the solution may be mentioned the gradual absorption of carbonic anhydride (or carbonic acid) from the air, and the consequent conversion of the free cyanide into carbonate of potash. This is for a time rendered harmless, or rather the dissolving quality of the solution is maintained, by the addition of free cyanide.

The greatest care is insufficient to prevent this action. There are, however, a number of troubles introducible by the experimenter. Sometimes the solution is improperly prepared, sometimes too large a proportion of brightening solution is added, and sometimes too much free cyanide is added. These are all mistakes which are easily made; while, again, efforts to improve the solution are a fruitful source of difficulty. Impurities, too, become troublesome, and if not carefully watched and guarded against, they will speedily render a solution unfit for use.

Amongst the plans or methods available for the separa-

tion of silver from a spoilt solution is one in which the silver is precipitated by the addition of acid. The precipitate having been dried, is then melted, and a quantity of silver obtained. Some of the metal, however, remains in the residue, which ought to be removed. It may be recovered by a further gradual fusing, or by dissolving and adding a piece or two of zinc and a small quantity of hydrochloric acid. The precipitated silver and chloride of silver is then well washed, dried, and heated with potash in a crucible, when the metal separates as previously indicated when dealing with the recovery of silver from stripping solutions. This process is, however, not commendable, more particularly to amateurs, as it is accompanied with the evolution of prussic acid and other almost equally pleasant (or unpleasant) gases.

Another process is to evaporate the solution to dryness, or nearly so, and mixing the residue with small quantities of nitrate of potash and common salt, fuse it till the silver is reduced to the metallic state and appears as a button at the bottom of the crucible. The molten metal may be obtained in the granulated form by pouring it into a quantity of cold water. The metal so obtained is not often pure, and, therefore, not fit to be used in preparing a fresh solution, or in making up into an anode. It has, however, a marketable value.

The best plan for amateurs, if not for trade purposes, is that suggested by one to whom all electrical students owe a debt of gratitude. The process is, to some extent, a modification of the one first mentioned; but the gases, which would otherwise prove a fruitful source of trouble and danger, are utilised in the preparation of a new plating solution. These gases are, therefore, not only prevented from acting injuriously, but are a cheapening element in subsequent processes. "Place the solution is a large flask, fitted with a safety-funnel and delivery-tube,* joined by an india-rubber pipe, to a wide glass tube, the end of which dips half an inch into a solution of silver nitrate in another vessel. Now add sulphuric acid gradually by the safety-funnel, allowing the effervescence to subside, and shaking the flask occasionally; continue adding acid as long as it produces any fresh precipitate. Then, by means of a sand-bath,† heat the flask, and keep the solution boiling as long as a precipitate continues to form in the other vessel. The precipitate is pure cyanide of silver, and only needs dissolving in cyanide of potassium to form the fresh solution. The precipitate in the flask is also cyanide of silver, but not pure, though sufficiently so for use in most cases. If it is preferred, it can be reduced by zinc and hydrochloric acid, or dried and fused." The saving above referred to is effected on the conversion of the nitrate of silver into the cyanide by means of the decomposition produced by boiling the bad solution.

Having, I think, said all that is necessary on the subject of silver-plating, I feel tempted to turn next to electro-gilding, but the practical difficulties are so many and so serious, while the expense is prohibitive to the majority of experimentalists, that I am compelled to defer, for a time at least, an account of the processes necessary or available to secure a good coating of the queen of metals. There are, however, a number of other metals almost if not quite as beautiful, and much cheaper to work. Some of them, too, involve questions of great interest, and will well repay one for the time and labour expended upon them.

* The safety-funnel should dip below the level of the solution, but the delivery-tube should only dip fairly into the flask.

† Consisting of a tin saucer containing a quantity of fine sand, in which the bottom of the flask is embedded. The object is, on applying the flame to the tin, to heat the flask uniformly, or as nearly so as possible.

THE WEATHER FORECASTS OF 1884.

By JOHN W. STANIFORTH.

AT the beginning of 1884, I submitted to the readers of KNOWLEDGE the results of an analysis of the forecasts issued by the Meteorological Office during the previous year. In doing so, it was necessary to show how those results were obtained, and to explain the system by which the forecasts were analysed, but having tested the predictions of the past year on the same principle, I shall now only state the results, referring those who care to go further into the subject, to my previous articles.*

I.—THE WIND.—(*a*) *Its Direction.*—During last year 301 predictions were made of the direction of the wind, as compared with 300 in 1883. The following table exhibits the proportional correctness of these forecasts for each month, those under A^4 being quite correct, under A^3 nearer right than wrong, under A^2 nearer wrong than right, and those under A^1 being hopelessly incorrect.

	A^4	A^3	A^2	A^1
January	16	5	2	2
February	17	6	0	3
March	22	0	0	2
April	18	2	1	2
May	19	3	2	1
June	16	2	3	4
July	23	1	0	2
August	14	4	4	2
September	20	2	0	4
October	19	4	0	4
November	18	4	1	1
December	16	7	3	1
Totals	218	40	16	27

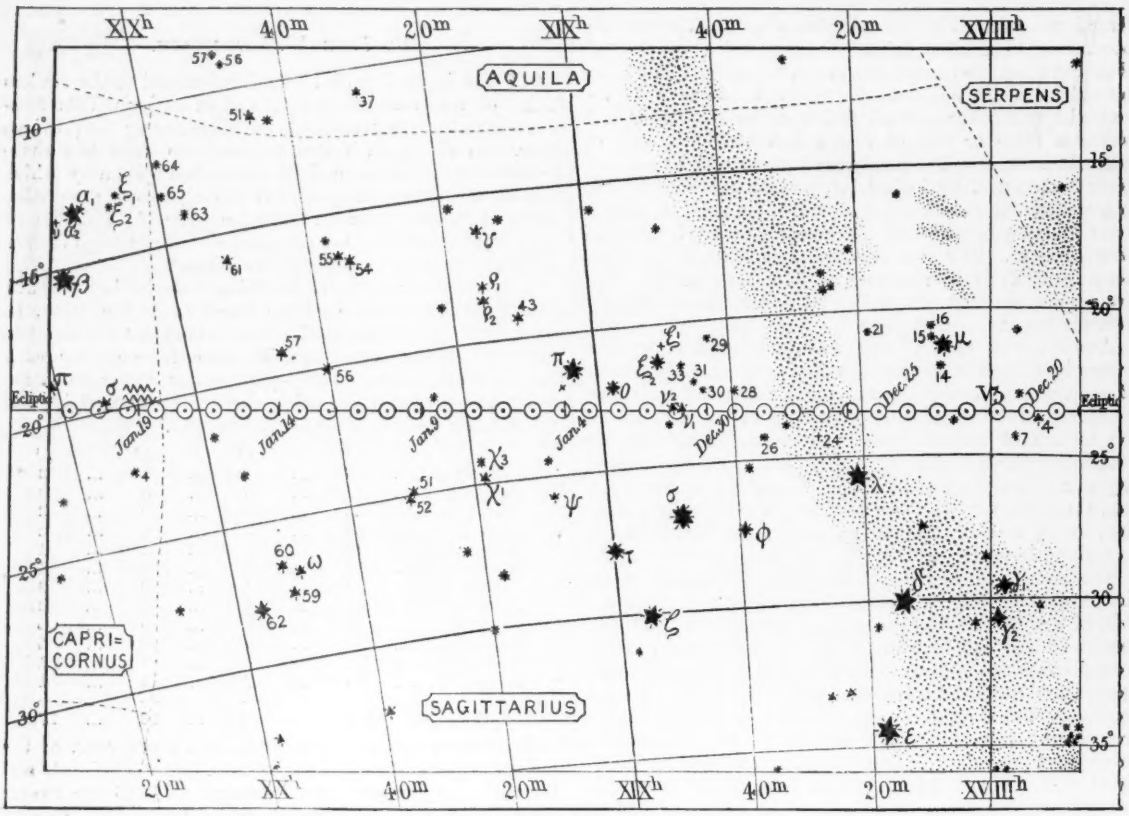
In other words, rather more than 72 per cent. of the forecasts were correct, 18 per cent. were doubtful, and less than 10 per cent. were wrong. In 1883 the figures were 66 per cent., 24 per cent., and 10 per cent., so that we may say there has been an appreciable improvement in the forecasts of the wind's direction.

(*b.*) *Its Force.*—291 times has the strength of the wind been predicted, and how far these predictions have proved reliable is shown in the following table, where the B's have the same values as the A's in the preceding list:—

	B^4	B^3	B^2	B^1
January	11	3	7	4
February	5	2	3	14
March	10	2	6	6
April	12	2	5	3
May	10	8	5	3
June	14	7	2	0
July	17	4	2	2
August	15	7	1	1
September	15	4	2	1
October	13	5	1	6
November	15	4	1	4
December	15	4	2	6
Totals	152	52	37	50

To summarise and compare these figures, we may say of the forecasts of wind-force that 52 per cent. were correct, 31 per cent. doubtful, and 17 per cent. incorrect, as compared with 60 per cent., 25 per cent., and 15 per cent. in 1883. This is a distinct falling off, for, although, as I have previously said, the table by which these forecasts are tested is of too arbitrary a character to do them full justice, the comparative results are in no way affected since both series were tested by the same table. In nearly all those forecasts which are classed under B^3, B^2, and B^1, the error has lain in too great a strength being predicted; very rarely, indeed, is the Meteorological Office *under* the mark.

* Vol. V., pp. 112 and 159.



The Day Sign for the Month.

II. The Weather.—(*a*) *Rainfall.*—Again I think it incumbent on me to state that, in testing the forecasts of rain, only those in which rain or snow was definitely predicted have been taken into account, such terms as "changeable," "unsettled," and "less settled" not being regarded as predictions of either rain or snow; 142 of these definite predictions were made, and 107 proved correct—about 75 per cent. In 1883 the figures were 167 prophecies, and 72 per cent. of successes. In addition, rain or snow fell on 73 days when neither was predicted, or on 13 more days than in 1883.

(*b.*) *Temperature.*—Nearly three times as many forecasts of temperature were issued last year as in 1883, and a far greater proportion of them were of *changes* in temperature. The percentage of successes, however, is not so high, being 70 per cent. in 1884, and 84 per cent. in 1883. Altogether there were 112 of these forecasts, and 79 of them were correct.

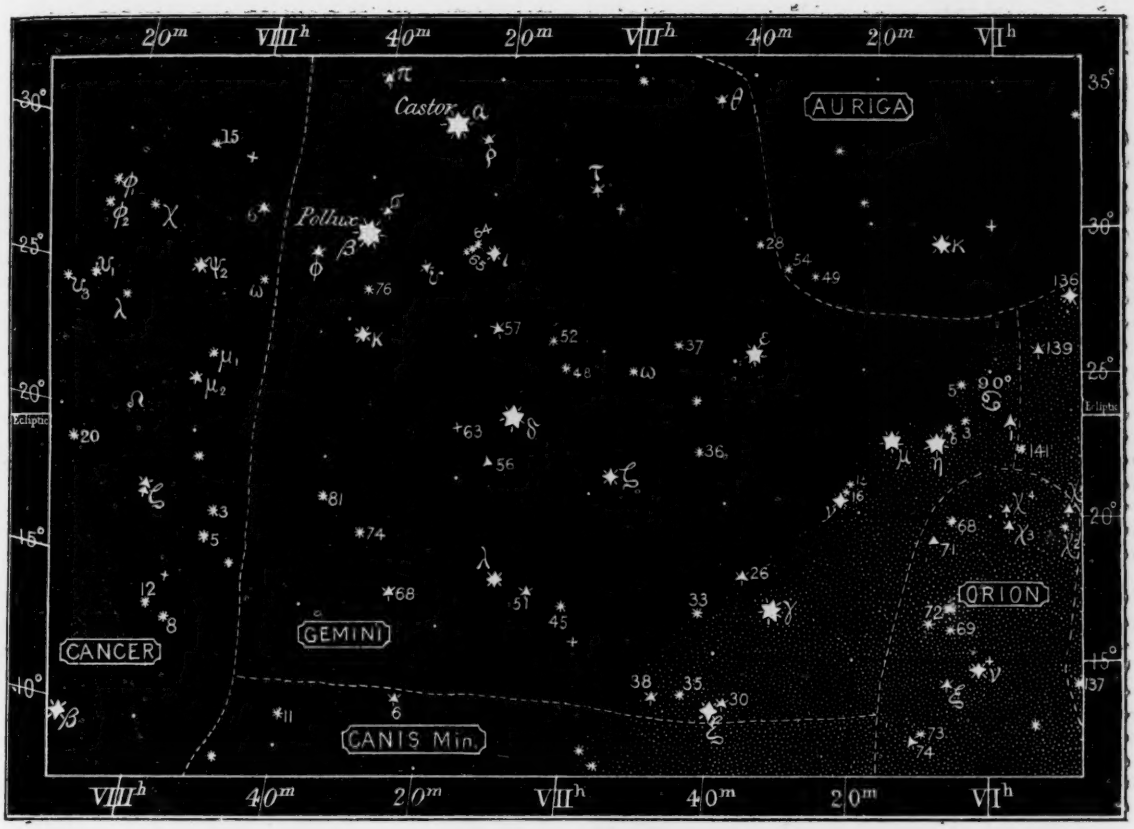
(*c.*) *Humidity.*—Eight times the office predicted a dry state of the air, and four times the prediction was verified. In 1883 dryness was only predicted twice, and then also the honours were divided. Fog or mist was prophesied 53 times—30 times correctly—about the same proportion of successes as in 1883, when 24 out of 42 were correct.

Taking the above figures into consideration, and also the other items that make up a weather forecast ("dull," "fine," "cloudy," "thunder," &c.), I drew up the following table, which shows at a glance the relative value of these forecasts for each month of the past year. C^3 represents correct, C^2 moderately correct, and C^1 incorrect.

	C^3		C^2		C^1
January	14	...		...	3
February	13	...	7	...	5
March	15	...	7	...	4
April	12	...	9	...	4
May	14	...	4	...	9
June	15	...	3	...	8
July	19	...	3	...	5
August	13	...	9	...	4
September	13	...	8	...	5
October	19	...	2	...	6
November	12	...	13	...	0
December	12	...	9	...	6
Totals	171	...	82	...	59
Totals for 1883	169	...	84	...	59

I have placed the totals for 1883 under those for the past year because they are so strikingly similar. As a matter of fact, little advance *has* been made in the matter of the weather forecasts, and I do not yet see any reason for changing the opinion I formerly expressed—that though the office may fairly congratulate itself on its wind predictions, it cannot take to itself much credit for its weather forecasts, nearly half of which are wide of the mark.

Finally, to take the two years together we find that out of 601 forecasts which the Meteorological Office has issued of the wind's direction, 417 have been correct; of 578 of the wind's force 325 have hit the mark; and that the office has blundered no fewer than 284 times in making 624 predictions of the state of the weather.



The Night Sign for the Month.

ZODIACAL MAPS.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

THE SUN'S HEAT.*

BY RICHARD A. PROCTOR.

PROFESSOR YOUNG, of Princeton, in a recent address at Philadelphia, expressed his belief that the contraction theory of the sun's heat is the true and only available theory. I believe so, too, and my object in the present paper is to dwell upon the significance and interest of this remarkable interpretation of the solar mechanism.

Of course it is known to all that the old theory according to which the sun's heat is due to combustion ("doubt that the sun is fire," said Shakespeare, as if the doubt were the quintessence of absurdity) has long since been rejected as futile. A mass of the best combustible material, equal to the sun in quantity, would be burned out at his actual rate of emission—if it *could* burn right out—in about 5,000 years. In like manner, the idea of the sun as an intensely hot body simply radiating its heat into space, as a piece of white hot iron does, without any process of combustion, has had to be rejected. Even if the sun were formed of matter possessing the high specific heat of water, which has the remarkable property of giving out more heat in cooling than any other natural substance known (and only one or two artificial substances surpass it in this respect), even then the sun's emission of heat at his present rate would not cover more than about 5,500 years. Processes of chemical change have been suggested as affording the true source of solar heat; but they in turn have had to be rejected as altogether insufficient. It is unnecessary to touch on the supposed origin of solar heat in the gathering in of meteoric bodies; for in reality this process belongs to the contraction theory; it has, however, been abundantly demonstrated that the actual amount of sun heat which could be derived from the drawing in of matter now outside the solar globe can be but very small. We are left, in fine, no resource—so far as our present knowledge extends—but to regard the process of contraction taking place within the solar globe as the true source of all or very nearly all the heat and light which the sun emits, and therefore of every form of force and life on this earth and on whatever other members of the solar system may be the abode of life, or a scene of the display of any forms of force not derived from internal heat and energy.

But now, at the very outset, what a mighty mystery is thus unveiled! It seemed wonderful enough to recognise in what we fondly call inert matter the source of the energies which guide the heavenly bodies in their motions. I know indeed nothing more mysterious (more hopelessly

* From the *New York Tribune*.

mysterious, one might say, if one could limit the possibilities of future research) than the Mystery of Gravity. It has been said, and truly said, that—

> Nature and Nature's laws lay hid in night.
> God said, "Let Newton be," and all was light.

All was indeed light where before men had been groping in darkness. But outside the region where they had thus been searching far vaster regions of darkness were revealed. A veil was lifted, and one of Nature's mysteries was interpreted, but a more impenetrable veil was seen beyond, which as yet no man has even hoped to lift. What greater mystery can there be than this, that matter acts where it is not? The sun on the earth and all his planets, the earth on the moon, Jupiter and Saturn on their world-systems, planet on planet, star on star, nay, every particle of matter on every other throughout infinity of space. And not only so, but time seems annihilated as well as distance. For it has been shown that unless the force of gravity traversed distances with far greater velocity, nay, with many times the velocity of light (187,000 miles per second), the whole mechanism of the solar system would long since have gone wrong. Nor has it yet been shown how minute the time intervals are in which practical infinities of distance are traversed by this all-pervading attractive action.

And now we find that not only is "inert" matter thus intensely, one may say infinitely, energetic, as a cause of motion, but that it is the real source of the light and heat, which are in effect the very life of the universe itself. Within our own earth, the movements we call earthquakes, as well as all such disturbances as volcanic eruptions, geysers, and so forth, are all primarily due to the process of steady contraction taking place under the action of terrestrial gravity, though, of course, the proximate cause of each such disturbance is the heat generated during the process of contraction. In each planet, no doubt, similar processes are taking place, with greater or less energy, according as a planet is younger or older. And now we see the mighty mass of the sun, steadily by its gravitating energy generating heat, whose emission is, in fact, the very life of the solar system. In other words, there resides in mere matter, in what we have so long and so idly called inert matter, the real source of every kind of movement, of every kind of life within the universe itself. For, what is true of our sun is true of his fellow-suns, the stars, not only of the thousands we see, but of the tens, the hundreds of millions revealed by the telescope, and of the millions of millions of galaxies of suns which doubtless exist beyond the domain surveyed by our most powerful telescopes.

But, turning from this stupendous, one may truly say this awful mystery, which seems to present gravitation as in a sense associated directly with the Great First Cause, we note that there are many minor mysteries about the theory that solar gravitation is the true source of solar heat.

In the first place, many find it difficult to understand how the shrinkage of even solid matter, still less that of vaporous matter, can lead to the generation of heat. Yet in reality, to any one who rightly apprehends the principle of the conservation of energy, it will be obvious that the heat generated as the solar gravity draws inward any portion of his envelope of vapours, and in so doing necessarily diminishes the volume of that portion, must be exactly the equivalent of the heat which would be required to reverse the process, and so to restore by expansion that portion of vaporous matter to its original volume. A real difficulty arises for a moment, when we inquire why the heat generated momentarily by the forces tending to produce contraction is not momentarily employed in producing equivalent counter-expansion. We must remember, however, that a portion of the heat generated must necessarily be radiated away into space, simply because it is exposed to the cold of space. One may compare the case to that of a pump so constructed that if all the water raised remained in a certain vessel round the place of exit, the weight of the water would serve as a source of power to keep the pump working. In such a case, were friction entirely gotten rid of, the pump would work for ever. But if the vessel were perforated so that all the time a portion of the water escaped, this would no longer happen. The heat constantly generated by the enforced process of solar contraction does in part escape; a portion continually undoes part of the work of contraction by causing expansion, but the portion which, as we see and feel, is continually escaping from the sun, causes a portion of the contraction to remain uncompensated. Thus the sun, as a whole, continues steadily contracting and steadily emitting heat. Nor will he cease to contract until he ceases to emit light and heat, or, in other words, until he ceases to be the beneficent, light-giving centre of the solar system.

But the most perplexing mystery in connection with the contraction-theory of the sun's heat is that the sun and the earth seem to tell a different story in regard to the amount of heat which has been poured forth. Judging from the sun's apparent size, it would seem as though not more than twenty millions of years of solar work, at the sun's present rate of working, could possibly have been done; for if he had gathered in his mass from any distances however large, that would be the absolute maximum of energy represented by the process of contraction to his present apparent size. But the earth's crust seems to tell us of a much longer period of sun work than this. If Dr. Croll, of Glasgow, whose results Sir Charles Lyell accepted, has rightly estimated the amount of work so done on the earth, it cannot represent less than one hundred millions of years of sun work. How can we explain the discrepancy? Professor Young accepts the sun's evidence as it stands, making only the proviso that if in past ages the sun was exposed to some violent shock, as by collision with another sun, more heat would have been generated. Dr. Croll takes the earth's evidence alone, and considers that there must have been such collision. For my own part, I consider it clearly proved in other ways (and it comes in well to remove this particular difficulty) that the sun's real globe is very much smaller than the globe we see. In other words, the process of contraction has gone on further than, judging from the sun's apparent size, we should suppose it to have done, and therefore represents more sun work. According to this view, however, the sun's future would last many millions of years less than it would if his apparent size is not far from his real size. But the limited allowance of future work we should assign to him—a few millions of years' work at the outside—is estimated on the assumption that only such densities as we recognise in terrestrial substances can be attained within the sun's mass. It may well be that under the conditions there existing, matter may attain densities far greater than we find here. If so, the sun's duration as the life-giving centre of a family of worlds may be far greater than has been commonly supposed.

The frequenters of the Science Lectures at the Royal Victoria Coffee Hall, Waterloo Road, will be glad to learn that they were resumed on January 13, when Prof. H. G. Seeley, F.R.S., lectured on "More about the Wonders of the Sun"; and on January 27, Commander Cameron will relate "How I got from the East to the West Coast of Africa."

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XI.—THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION—(*continued*).

IN a letter to Mr. J. Conyers Morrell, the founder of the modern ash system for the treatment and utilisation of household refuse, Dr. W. Moore, of May Fair, very pithily remarks:—"If prevention is better than cure in disease, it is no less so in sanitary matters. The dry system goes to the root of the evil, and prevents the formation of sewage fluid in its worst and nastiest form. It is only when human excreta are mixed and churned up with water that poisonous gases are generated, enteric fever diffused, rivers polluted, and public decency outraged. The water-closet system is a delusion and a snare. It makes sewage, it is bad in principle, it connects each house with the sewers, as if on purpose to poison or offend the inmates with foul gases; it does not touch the fountain-head, and it wastes a valuable fertiliser. It puts excrementitious matter into one end of a long tube, at the other end of which are found a congregation of civil engineers and chemists frantically engaged in the vain work of undoing what has been done." This may be taken as almost a summary of the value of the process; but to be precise, we may formulate its advantages, and redirect the attention of our readers to those premises, given in our immediately foregoing chapters, from which our conclusions are drawn.

(*a*) The original cost of the apparatus required is much less than that for an ordinary water-closet. As it is not open to damage from frost, the expenditure for repairs is obviously almost *nil*. When improper substances, such as stones, large pieces of paper, &c., are thrown into the receptacle, they lie there perfectly harmless; whereas, we are able to state from experience that the prevalent syphon pipe of a hopper or other basin is a source of constant annoyance of the worst character from this cause.

(*b*) The quantity of water used is considerably diminished, and there is no loophole here for the contamination of the cistern. Our observations in several parts of this city have shown that the majority of buildings of moderate size, and of date anterior to about 1865, and many of even recent erection, are most unwholesome in this respect. A common form is where the closet water-supply comes directly from an exposed or an inaccessible cistern overhead, which also supplies the scullery sink and kitchen. Another variety is only an improvement on the above. There is a kind of semi-disconnection of the cistern from the closet-pipe by the intervention of an inefficient water-waste preventer.

(*c*) As an absorbent, deodoriser, and disinfectant, earth and ashes applied to excrement is a positive preventive to the rise and spread of zymotic disease. The combination of the earth with the waste matters is directly antagonistic to the development of germs and the foul exhalations which are always attendant upon fermentative processes.

(*d*) The resultant product is a manure of the high value of £3 per ton, which may be permitted to accumulate in vaults for months without any disadvantage, or can be removed at short intervals, from specially-constructed apparatus, in the ordinary dust-cart, without the slightest degree of offence; indeed, the removal of decomposing garbage from the dust-bin of the present day is open to greater objection. The total quantity of waste matter thus periodically removed is only equal to, or even less than, the aggregate of the filth of to-day; so, that, far from an increase of expenditure for its removal, there may be, under careful management, an appreciable decrease. We must also bear in mind here, that there is an enormous saving at the same time of rates for water, and the total abolition of expensive sewage works. Directly and indirectly, therefore, the pecuniary gain would be almost fabulous.

(*e*) It has been estimated that the system can be perfectly organised for communities of 10,000 persons, presided over by special local boards, and that the authorities so constituted can make it pay amply for all expenses. Here, then, is room for a redistribution of local boards, to be gauged by the number of individuals within each sanitary boundary.

We have now stated enough regarding the dry system for dealing with refuse matters to show conclusively that it deserves to become, ere long, the dominant practice of the future. We have shown that the modification of the present hydraulic system might easily be effected by apportioning the work of each district to its local authorities, and that the initial expenditure need not be so great as to overtax the purses of landowners and house proprietors. Yet nevertheless, the joint boards seem to be bent upon carrying all these products, that would otherwise be valuable, by an immense unventilated and costly sewer to the sea. This measure, if carried out in its integrity, will retard the progress of sanitary science of the highest order, and although it may be found effectual, the result will be attained at the increased taxation of the public, a waste of much valuable material, an intermittent drought of the river Thames, and the enrichment of the water companies.

The dry system, on the other hand, if universally introduced, would probably cause an increased taxation *pro tempore*, but, in the course of time, it would develop into a vast source of wealth to the country; it would secure for us freedom from epidemics, extreme cleanliness in our homes, and no undue waste of the water of our rivers, which will then be able to return to their original purity. Instead of the enrichment of water companies, the public will be incalculably benefited. Let us hope that the time is at hand when the reverse of Charles Kingsley's words ("The sewers vomit their pestilential riches into the river, hurrying to the sea vast stores of wealth, which might be elaborated by nature's chemistry into the ready materials of food; proclaiming, too, by their foul smell, God's will that their contents should be buried out of sight, in the fruitful all-regenerating earth. We despise His laws, and therefore are afflicted with pestilence, filth, and drunkenness,") will become the order of the day.

Although we have anticipated matters thus far, we must bear in mind that the sewage system is a present and prevailing evil, and it therefore remains for us to consider those principles which ought to be carefully attended to in a house provided with pipes for the removal of excrementitious matters.

(*i*) Soil-pipes ought never to be included within the shell of the building; that is a recognised fact amongst even the most unenlightened builders. Many houses, however, which may be said to have been built in pre-sanitary times, still harbour internal soil-pipes, and it is invariably the case that where such a state of affairs obtains, the closet is packed away beneath the staircase, in a position where it can be but ill-lighted, and still less well ventilated. Nearly all the serious faults of a badly-placed closet are generally found associated; its obscure position, away from the fresh air and sunlight, is an incentive to the "penny-wise and pound foolish" landlord, who tries to save labour and expense in omitting to plaster the partition, and fasten floor-boards beneath the seat. This is a constant cause of escape of foul air into adjoining apartments, and to it may

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often be traced the source of illness. An inside soil-pipe is also liable to be a patchwork of anything handy, with its joints stuffed with putty, the external part of the pipe is then covered with paper, or painted, and very soon requires the regular visits of the plumber to stop leakage and the escape of unwholesome gases. We have to be very thankful, however, that our British workman is not "up to the dodges" of his American brother in furnishing modern improvements, ventilators, &c., which are in reality but diverticula into walls, and apparent continuations aloft in dummy terminals.

"CARRYING" TRICYCLES.

By John Browning.

Chairman of the London Tricycle Club.

THE "DESPATCH."

THE use of the tricycle as a carriage for transporting light goods and delivering them in towns is rapidly increasing.

The Despatch Tricycle.

A great impetus will be given to the use of the machine for this purpose by the introduction of the "Dispatch" tricycle by Messrs. Starley & Sutton, of Coventry. This machine is *par excellence* the carrying tricycle. It seems to me to fulfil every possible requirement of safety, speed, and facility for rapid delivery. The back of the machine being quite open and free, the rider can mount and dismount instantly without stopping the machine. In starting the rider can push it for a few yards, and, getting up a momentum, quietly put his foot on the crank, which, by revolving, will lift him easily into the saddle, or, if he prefers doing so, he can mount by means of a step.

When heavily loaded, the machine can be pushed by both hands up a steep hill.

In dismounting, the rider can slide quickly off the saddle or dismount from the step, in either case without leaving his hold of the handles, thus retaining a perfect command over the machine, in case of danger or necessity, even if the machine be travelling at the rate of twelve miles an hour.

The machine is fitted with two band-brakes. These will stop the machine in a few yards when running down a steep hill, or lock it when standing.

The driving-wheels of the "Despatch" are forty inches, geared down to about thirty-six inches, for the sake of obtaining power and ease in driving.

As will be seen from the engraving, the machine is a front-steerer, and the front steering-wheel is half the size of the driving-wheels, and is between three and four feet in advance of the driver. The weight carried in the basket is midway between the three wheels, and therefore vibration is reduced to a minimum.

A small, light machine, made on this plan, would be admirably adapted for carrying a full-sized set of photographic apparatus to take large pictures.

I wish the enterprising and ingenious makers of the "Despatch" would bring out a *small-wheeled* front-steering tricycle on the same lines, with 36-in. driving-wheels driven by ratchets, thus giving the combined advantages of double driving with free pedals, the machine to be geared from 55 to 60 in. to suit the requirements of the rider. Of course, the rider would sit further forward, and the front steering-wheel would be brought further back than in the "Despatch."

Such a machine would be light, fast, and strong, and it could be made cheaply if manufactured in numbers; but if any of my readers should order a single machine built on such a plan at a low price, I must assure them that they cannot expect to get it; for although, if made in numbers, the machine could be sold at £20, a single machine, if made of the best materials and workmanship, could not be sold much under £30.

I must take this opportunity of saying, also, that my readers must not expect to obtain all the advantages of the numerous contrivances I have described, praised, or recommended combined in one machine, because while they may have been highly beneficial in the particular tricycles on which I have tested them, yet they would, in many instances, be incompatible with each other.

Technical Education in London.—A complete "ladder of endowments" in the matter of technical education has just been set up by the Trustees of the Mitchell City of London Charity for the advantage of boys resident or employed in the City. There are first of all twelve scholarships to the Cowper-street Middle-class School; holders of these scholarships are then eligible at the end of the school course for further, although, of course, fewer, "Mitchell Scholarships" at the Finsbury Technical College; and from there the fittest may proceed again with "Mitchell Scholarships," to what will be the Technical University, in Exhibition-road. The scholarships at the Cowper-street Schools are to be competed for this month, and particulars may be obtained from Dr. Worwell, the head-master.

The crew of the American ship *Alert*, from New York to Shanghai, with 40,000 cases of oil, which was burned on Nov. 14, about 500 miles north of the Equator, were rescued by the French steamship *Comte D'Eu*, from Havre to Pernambuco, and have been landed at New York. During a squall the vessel was struck by lightning, which shattered the fore royal mast, but apparently did no other damage. Half-an-hour afterwards smoke was discovered issuing from the fore hatch. After other efforts to quench the fire had failed, the hatches were battened down, but were quickly blown out by a terrific explosion. The ship was finally abandoned, but the boats remained close by, and the crew were rescued next morning by the steamship, attracted fifty miles away by the light of the burning vessel.

The *Standard's* New York correspondent says:—A *résumé* of the commercial statistics of 1884 gives the following interesting particulars:—The number of business failures in the States was 10,968, the largest ever known, and 1,784 over those of 1883. The liabilities of these bankrupts amounted to 226,000,000 of dollars, which was 54,000,000 dols. over 1883. On the New York Stock Exchange the total sales transferred the ownership of shares valued at 96,000,000 of dollars—about the same sum as in 1883; in 1882 the sales were 113,720,665 dols. The Clearing House Exchanges dealt with a value of 32,457,732,582 dols.; in 1883 the amount was 38,998,978,968 dols. The cotton sales were 24,062,500 of bales; in 1883, 25,634,700 bales. The value of the staple products of the country have declined in the same way as Stocks, except cotton; wool, 33 to 41 last year, against 21 to 23 to-day; pig-iron, 20½ to 21½ dols. per ton last year, against 18 to 18½ to-day; steel rails, 33 to 35 then, against 28 now; wheat, 110¾ then, against 84½ to 85⅝ now; corn, 65⅝ in 1884, against 52 in 1883; pork 14·75 a year ago, against 12 dols. to-day. The number of immigrants who arrived at the Castle Garden depot, New York, in 1884 was 388,267, against 320,706 in 1883. The annual statistics of the city of New York show a surprising increase in the number of suicides, namely, 226, against 161 in 1883.

Editorial Gossip.

I LEARN from the current number of the *American Naturalist* that ignorance, bigotry, and superstition may flourish as rankly under a Republic as under the oldest European monarchy; and that the howl which was raised by the stupidest and worst-informed of our English "Ministers of Religion" against the theory of Evolution, is being re-echoed from the other side of the Atlantic. The Presbyterian body in the United States would seem to have dismissed Dr. Woodrow from his chair at the Theological School at Charleston; to have subjected Dr. Kellogg, of Pittsburgh, to "disciplinary proceedings" for daring to proclaim this theory; and, in fact, to be driving what little intellect there is in their communion out of it.

APROPOS of the way in which some men contrive to make dignities "pay," I heard the other day of a scientific luminary, who, while he was (say) Mr. Smith, was asked for an estimate for certain work, which he gave. From a cause needless to be entered into here, the work temporarily fell through. Meanwhile, however, Mr. S. had blossomed into Sir John Smith, and on being again approached on the subject, presented a very considerably-increased estimate. "Ah," said the man who had applied for it, "I see how it is; you charge extra for (K)night work."

So the gentleman who really did certain photographic work, so much be-puffed as some one else's (in the true "Pears's Soap" style) in the *Times*, is to proceed to the Cape to photograph the stars for an Atlas of the Southern Celestial hemisphere. Well, I hope that the British taxpayer will get his money's worth for his money. Mr. Espin has been doing similar work admirably in Liverpool without costing the country a single farthing—but that is a detail. I note, too, that Mr. Woods is to continue at the Cape his photographic records commenced last year in Switzerland of the solar corona by Dr. Huggins's method. Is the nation to pay for that, too?

I SPOKE last week (p. 33) of the possibility that the earthquake waves which have been desolating parts of the Spanish peninsula may have been transmitted in an exceedingly attenuated form to this country. As an illustration of the manner in which terrestrial concussion or vibration may be transmitted, a friend resident at Blackheath tells me that the explosion by which some cowardly vermin attempted to destroy London Bridge so shook the floor of his kitchen that his servants imagined that the floor was about to sink into the earth. His house is situated $4\frac{3}{4}$ miles from the scene of the explosion "as the crow flies."

THE spurious fiddle trade, to which I referred on p. 283 of the last volume of KNOWLEDGE, would seem to be languishing, and pseudo-Cremonas to be what I believe is commercially termed, "very flat" in the market. Here is the latest advertisement which has caught my eye:

> Violin, labelled inside "Joseph Guarnerius, fecit in Cremona 1749." Very handsome, splendid tone, thorough condition. Complete, with silver-mounted bow and almost new case. Take 10s. 6d. for lot. Rare bargain, but no use to me.—Address I. Tay-Cummin, Rookingham, Diddlesex.

"Oh, what a falling off is here!" Why, six months ago, one of these Staduarius-Guarnerius-Amati violins was scarcely purchasable under £1. 5s., and now is offered, "with silver-mounted bow and almost new case," for 10s. 6d. the lot! Why, the happy purchaser might, by disposing of the silver-mounting of his bow and the "almost new case," actually get this glorious old Italian instrument for nothing. I do hope, though, that he would not have to repeat the concluding words of the advertisement.

THE present season seems calculated to inflict yet another blow upon the pretty old superstition that a superabundant appearance of berries presages a severe winter. Rarely has there been seen such a profusion of holly-berries as loaded, and load the trees just now; but as to the "hardness" of the winter, a glance at the utterly filthy state of the London streets will show how dismally the prediction of that has failed.

Reviews.

SOME BOOKS ON OUR TABLE.

The Wave of Translation in the Oceans of Water, Air, and Ether. By JOHN SCOTT RUSSELL, M.A., F.R.S. (London: Trübner & Co. 1885.)—This is a new edition of the classical work on the "wave of the first order" by the great and lamented physicist who has passed from us; and embodies the results of his investigations and researches up to the time of his death. As is well known, it is to Mr. Scott Russell that we owe the classification of waves, and their distinction according to their genesis and laws of propagation. In the work before us, while the laws educed by its author, from observation and experiment, are first shown to explain the motion of the Aqueous Ocean, our author proceeds to apply them to the Ocean of Air, and even to the Ocean of Ether. It is probably in the latter part of the work that the student of physics will find most that is novel and startling. To attempt a *précis* of a book of this kind would be futile, but its title and the name of its author will prepare all interested in its contents for their nature and extent. Of their interest and importance the reader will speedily judge for himself.

A Catechism of the Steam-Engine. By JOHN BOURNE, C.E. (London: Longmans, Green, & Co. 1885.)—This fresh edition of Mr. Bourne's admirable and widely-known "Catechism" is practically a new work, a large portion of it having been re-written, fresh woodcuts engraved, and two chapters (one on Air- and Gas-Engines, and the other consisting of Useful Rules, Tables, and Memoranda) having been added. Moreover, the modern theory of thermodynamics has been fully expounded; and, directly or indirectly, a large amount of information on general physics imparted. Hence it will be seen that the possession of former editions of Mr. Bourne's book by no means absolves the student from the necessity of procuring the present one as soon as he possibly can. It is a book with which no mechanical engineer can afford to dispense, and which should be upon the shelves of everyone who wishes to understand the theory and practical construction of the steam-engine.

A Treatise on Dynamics. By W. H. BESANT, D.Sc., F.R.S. (London: George Bell & Sons. 1885.)—Dr. Besant's reputation as a tutor and mathematical author would naturally prepare us to expect that his treatment of the not-too-familiar subjects of Kinematics and Kinetics would be at once full, accurate, and intelligible. Nor were we disappointed in the perusal of the volume now on our table. His discussion of his subject (largely by the analytical method) is conducted in a manner calculated to appeal to the intellectual type of the average student, the laws expounded being illustrated by simple cases and examples, which, however, gradually increase in complexity and

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difficulty. Our author says in his preface, "My especial object has been to illustrate the direct application of the laws of motion, and thereby to produce a treatise of an elementary character, but of educational utility to the student who is commencing the study of theoretical kinetics." He may fairly claim to have succeeded.

The Siege of London. By "Posteritas." (London: Wyman & Sons. 1885).—Some years ago, a work entitled the "Battle of Dorking" created a considerable sensation, in showing how vulnerable these islands were to foreign invasion. Following upon similar lines, "Posteritas" prophetically indicates the outcome of our present (so-called) "Liberal" policy, and describes a French invasion of England and the siege of the Metropolis. Not unmindful of the strategy which led to the disaster of Islandwhana, and of the tactics of Maiwand and Majuba Hill, we would yet fain believe that the crass stupidity with which our author credits the British military authorities is—to use a mild term—exaggerated. Nevertheless, in the words of the old proverb, "There is many a true word spoken in jest," and this little book contains hints by which even the *Dii majores* of the Horse Guards and the Admiralty may conceivably profit. *Si vis pacem, para bellum.*

Differential Calculus for Beginners. By Alexander Knox, B.A., Cantab. (London: Macmillan & Co. 1884.)—This is, without exception, the best book for the very beginner in the differential calculus that we have ever met with; that *bête-noire* of the incipient student, the differential co-efficient, being made intelligible in a manner which is as novel as it is ingenious and effective. Mr. Knox's mere notion of rendering the geometrical idea of points and lines easily apprehensible by means of coloured rectangles of paper, of itself shows how thoroughly he grasps the little difficulties which beset the beginner. We shall be strangely surprised if the circulation of this tiny volume is not very large indeed.

Factors in Algebra discovered by Arrangement, Trial, and Symmetry, with Applications. By Rev. J. G. Easton, M.A. (London: Groombridge & Sons. 1884.)—Here is another useful book for a beginner, who all but invariably finds a difficulty in factorising an algebraical expression of the slightest complexity. Beginning with the easiest cases, Mr. Easton gradually leads the student on through a series of increasing difficulty. Not to speak irreverently, factorising is to no small extent a matter of "dodges," and in these our author is particularly strong. His book will be found valuable by the incipient algebraist, whom it may and will save many a five or ten minutes' weary and purposeless pondering.

What is Religion? By C. N. Annotated by Robert Lewins, M.D. (London: W. Stewart & Co. 1883.)—Into the theological portion of this curious pamphlet we will not, and into its metaphysical part we need not, enter. Here we have the Ego and the non-Ego once more warmed up. Briefly, the Universe must be held to consist of the sum of Dr. Lewins's sensations. We seem to have heard something remarkably like this before.

Brass Repoussé. By Madame Amélie. (London: Published by the author.)—In simple language, illustrated by well-executed and intelligible wood-cuts, Madame Amélie gives directions for the production of that brass repoussé work which has recently been resuscitated. Ladies who require a novel, interesting, and artistic form of recreation will find it in the practice of the art so plainly described in the little work before us.

We have also on our table *The Journal of Botany, The American Naturalist, The Medico-Legal Journal, Heath's Fern Portfolio, The Medical Press and Circular, Bradstreet's, The Tricyclist,* and *Society.*

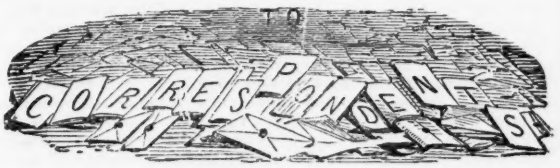
THE FACE OF THE SKY.

From Jan. 16 to Jan. 30.

By F.R.A.S.

THE usual daily examination of the Sun for spots and faculæ will be made, whenever the weather permits. The aspect of the night sky is shown in Map I. of "The Stars in their Seasons." Both Mercury and Venus continue to be most unfavourably placed for the observer. Mars is invisible. Jupiter—to the east of Leonis, and travelling towards Regulus—is by far the most brilliant and conspicuous object in the night sky, and he and the phenonena of his satellites supply the young observer with a series of the most interesting and instructive sights. Of such phenomena occurring at convenient hours during the next fortnight, the following are the chief:—On the 18th, Satellite I. will disappear in eclipse at 10h. 46m. 46s. p.m., and the shadow of Satellite II. enter on to Jupiter's face eight minutes after midnight. On the 19th, the ingress of the shadow of Satellite I. will take place at 8 p.m., but it is doubtful whether it will be visible, as Jupiter will be so low down. The transit of Satellite I. itself begins at 8h. 42m. p.m.; the egress of its shadow at 10h. 20m. p.m.; and that of the satellite at 11h. 2m. On the 20th, under unfavourable conditions, Satellite I. will re-appear from occultation at 8h. 13m. p.m.; as will Satellite II., later on, at 11h. 15m. p.m. On the 22nd, Satellite III. will enter on to Jupiter's face at 7h. 58m. p.m.; though here again it is doubtful whether it will be seen to do so. Its shadow will pass off his opposite limb at 9h. 1m p.m.; while Satellite III. itself will not follow it until 11h. 33m. p.m. This transit should be carefully watched to see whether the Satellite shows as a light or a dark spot on the disc of the planet, or changes from one to the other. On the 25th, the egress of Satellite IV., which will occur at 9h. 40m., should be observed for the same reason. On the 26th, the shadow of Satellite I. begins its transit across the planet at 9h. 54m. p.m.; followed by the Satellite casting it at 10h. 28m. p.m. The shadow leaves Jupiter's opposite limb at 12h. 14m. p.m., and the Satellite at 12h. 47m. p.m. On the 27th, with Jupiter close to the horizon, Satellite I. will be eclipsed at 7h. 8m. 25s. p.m., as will (under more favourable circumstances) Satellite II. at 9h. 33m. 1s. p.m. Satellite I. will reappear from behind the body of the planet at 9h. 58m. p.m., Satellite II. not until the next morning. Perhaps Satellite I. may be seen to leave Jupiter's disc at 7h. 13m. p.m. on the 28th, an observation which applies to the egress of the shadow of Satellite II. at 6h. 54m. the next evening. Later on the 29th the egress of Satellite II. occurs at 7h. 54m. p.m., the ingress of the shadow of Satellite III. at 9h. 19m. p.m., and that of Satellite III. itself at 11h. 19m. p.m. Its shadow leaves Jupiter's opposite limb at 12h. 59m. p.m. Saturn continues in an excellent position for the observer, and to repay all the attention that can be given to the scrutiny of his marvellous system. He continues to form a rudely isosceles triangle with β and ζ Tauri, as stated a fortnight ago on p. 15. Uranus has not yet arrived in a favourable position for the amateur, and, as we have so often said recently, Neptune can only be picked up as a small, dull, fixed star by fishing in that blank part of the sky to the S.S.E. of δ and ζ Arietis. The Moon was new at 8h. 36·5m. this morning, will enter her first quarter at 1h. 26·3m. a.m. on the 24th, and be full on the 30th at 4h. 19·2m. in the afternoon. Several occultations will occur at convenient hours during the next fourteen days, all of the stars, however, being small ones. On the 21st, B.A.C. 57, of the 6¼th magnitude will disappear at the dark limb of the Moon at 5h. 39m. p.m., at an angle of 144° from her vertex, reappearing at her bright limb at 6h. 52m. p.m. at an angle from her vertex of 309°. On the 22nd e Piscium, a 5¼th mag. star, disappears at the dark limb at 5h. 33m. p.m. at a vertical angle of 112°. It reappears at the bright limb at 6h. 47m. p.m. at an angle of 324° from the vertex of the Moon. On the 26th, B.A.C., 1526, a star of the 6th mag., disappears at the dark limb at 7h. 13m. p.m. at an angle from the vertex of 19°; to reappear at the bright limb at 7h. 49m. p.m. at a vertical angle of 325°. On the 27th the disappearance of the 6¼th mag. star B.A.C. 1930 happens at the dark limb of the Moon at 8h. 38m. p.m. at an angle of 33° from her vertex: its reappearance at her bright limb at 9h. 30m. p.m. at an angle from her vertex of 316°. Lastly, on the 30th, B.A.C. 3122, of the 6¼th magnitude, will disappear at the Moon's bright limb at 8h. 54m. p.m. at a vertical angle of 30°; to reappear at her dark limb (very close indeed, though, to what is seemingly a bright one) at 9h. 59m. p.m., at an angle of 237° from her vertex. The Moon leaves Sagittarius for Capricornus at 2 o'clock this afternoon, travels through the latter constellation during the day and night, and at 9 o'clock to-morrow morning enters Aquarius. She actually occupies until 2h. p.m. on the 20th in her passage across the whole width of Aquarius, and it is not until the hour just named that she crosses into Pisces. Exactly three days later, *i.e.*, at 2 p.m. on the 23rd,

she completes her path through Pisces and enters Aries. She is travelling through Aries until 6 a.m. on the 25th, when she crosses the boundary into Taurus, passing through the last-named constellation, and arriving at the western edge of the narrow strip of the northern part of Orion at 4h. 30m. in the afternoon of the 27th. She takes approximately 12 hours to cross this and emerge in Gemini. At 4 p.m on the 29th she quits Gemini for Cancer. She is in Cancer up to midnight on the 30th.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

THE WEIGHTS AND MEASURES ACT AND A NEW DECIMAL COINAGE.

[1561]—A report has recently been presented to Parliament by the Board of Trade, relating to the Weights and Measures Act. It contains matter for much thought and consideration, especially for those who have given the subject any attention. We have only recently got into working order a standard wire-gauge, and now we find many persons are anxious to see our system of the two-foot rule displaced for the metric craze, which, moreover, is not a measure with any certainty. We have it stated that in 1844 there were 453·5924277 grammes to the imperial pound; but it is to be 453·59265 from 1884. The mètre, which was 39·37027 in., is to be 39·37079. We may expect in a few years hence to see these metric standards corrected again, when it is found that the North Pole is more or less distant from the Equator. If the Continental nations that have legalised the metric system had taken their gauge from some certain aliquot part of the British standards, it would have been much better for them, and they could at any time have verified and tested their accuracy. There can be no doubt that our own system is complicated, and the great variety of weights and measures need very much to be simplified and put into a fixed and proper order.

Our coinage is far from being satisfactory. There is no reason why a decimal system might not with great advantage to British commerce and the public be adopted, provided it could be effected without loss on the one hand or gain on the other. The change might be made, I think, without very materially disturbing the present coinage. The manner in which this could be carried out is the following:—To use the sovereign, half-sovereign, florin, penny, halfpenny, and farthing, also to issue a coin to represent the tenth part of a florin, which might be called a "mite," being the smallest sized coin. There would be three columns of figures in keeping accounts, as at present. It would necessitate the withdrawal of crowns, half-crowns, shillings, sixpences, fourpences, and threepences. We would require for current use the following coins:—

Gold sovereign	=	10 florins.
„ half-sovereign	=	5 „
Silver florin	=	25 pence.
„ tenpence	=	10 „
„ fivepence	=	5 „
„ mite	=	2½ „
Bronze penny	=	1 „
„ halfpenny	=	½ „
„ farthing	=	¼ „

The bronze coinage would suffer a loss of 4 per cent. on account of the sovereign being equal to 250 pence. This, however, makes no real difference to the normal value of accounts; the amounts remain the same undisturbed. Take the following as examples:—

Old Style.		New Style.
£. s. d.		£. f. d.
59 18 9	equal	59 9 36
5 15 5¼	„	5 7 71
17 6 2½	„	17 3 10
1 19 11¾	„	1 9 99

These examples will show at a glance how any sum of money may be changed from old to new style without much mental effort. It will be always needful to have double figures in the pence column. The first may be read as mites, the second farthings. In the first example you may read 3 mites 6 farthings, or 36 farthings. There will be less disturbance to make the coinage of the decimal system by the method I propose than by any previous plan; in fact, we have the whole thing nearly ready to our hands. We require fewer pieces of coin in circulation than there are at present, viz., 13. I propose nine as being ample, and no coin could be mistaken for another in kind or value. I feel certain that trade would receive an impetus and accounts would be much easier kept if the change were made from the present unsatisfactory method of pounds, shillings, pence, and farthings, with a relative bearing to one another by 4, 12, and 20, to a system where 10 would serve for each. It will be seen from the above that the American dollar and the French franc are duly represented by two florins and tenpence respectively.—Yours, &c., JONATHAN PICKERING.

Globe Works, Stockton-on-Tees, January, 1885.

THE RECENT GREAT SUN-SPOT.

[1562]—I observed in KNOWLEDGE, of this week, that a correspondent had seen, by the naked eye, with a smoked glass, a splendid sun-spot. Here, on the 23rd, and in Edinburgh on the 28th, I saw it most distinctly, without much effort; also by the naked eye, without any smoked glass; the sun being finely shaded with thin clouds.

That the maximum is past we have reason to believe, but this same fact, when known, makes many of our observers more careless, as the interest is not the same; consequently, spots, such as the above, may come and go, few knowing anything about them, and some of those would rather be silent about them.

On the 19th, when drawing the fifth rotation of a group—three of which, by your favour, appeared in KNOWLEDGE—I chanced to see this great spot. I say "great," because it appeared larger than any I saw last year.

I got fair drawings of it on the 20th, 21st, and 24th, which I enclose for your inspection. A marked change will be observed between them.

The one drawn with a direct eye-piece seems as if I had inverted it to compare them better; but this is not the case.

22, Nilson-place, Stirling. G. L. BROWN.

[Three well-executed drawings accompanied Mr. Brown's letter. —ED.]

THE SENTIENT WORLD.

[1563]—Dr. Robert Lewins has not quite apprehended the purport of my wonder that "metaphysicians have made so little use of the fact that light and colour have no external existence whatever, but as mechanical vibratory action." For metaphysicians I ought rather to have written theologians. All men accustomed to abstract thinking are, of course, conversant with Berkeley's unassailable position, that we can only know the phenomena of our inner consciousness—that the existence of matter is but a belief, for which it would be preferable to substitute the belief in the immediate causation of a divine *nous*. But there is something more for the human mind to ponder over than that which occurred to Berkeley. Light, colour, sound, heat, cold, pain, pleasure, tastes, odours, feeling, thought, life, are all vital experiences that appear to me to have no analogues in the frigid materialist concept of external existence. Colour and sound are not images of external things, of mechanical vibrations. Nor are pain and pleasure images of material existences, &c., &c. Here, then, we perceive that we have a world of sensuous experiences that have no resemblance whatever to our conception of outer things a world of experiences which neither resemble object nor subject; a world of experiences that science cannot analyse; a world of experiences that seems to justify the exclamation, "There is more in heaven and earth, Horatio, than is dreamt of in your philosophy."

After writing the letter 1533 *ante*, referred to by Dr. Lewins, I find that I made the following note:—"It does appear to be somewhat cruel to interfere with the vulgar attribution of externality to light and sound. And yet one cannot believe otherwise than that every step forward towards truth will bring us nearer to some

more certain and consoling concept of existence. What if we should come to understand that that material world, about which scientists and Positivists are so certain, should be merely the medium for calling up the evidences of another existence that we can know *per se*, and that, in the instance of colour-sensations, the mechanical vibrations are but the media for exciting in the living sense properties which belong to a more universal life?" The "things which are seen were not made of things that do appear." The foregoing remarks I wish to be considered as suggestions only, as suggestions that have not yet assumed form and consistency, and which require, indeed, a greater command over words than I possess to clearly and perfectly express. W. Cave Thomas.

MATTER.

[1564]—In returning to the question as to whether Hæckel's statement about the unalterable nature of atoms fulfils the conditions of belief, "F. W. H." says that he agrees with me that "the mere statement of an eminent man has no claim upon our acceptance, unless it be in accordance with reason and logic." So far, then, we are in accord; but the point upon which we differ is this, that whilst he seems to regard Hæckel's statement as being one "in accordance with reason and logic," I do not so consider it. To me it does not seem an inference which it is fair to make from experiments, and most assuredly I cannot think of it as a statement *derivable* "from experimental experience."

I quoted Professor Clifford's "Ethics of Belief"—"to prove what? That Hæckel's opinion upon atoms is an error of judgment?" *Yes*, for the simple reason that Hæckel cannot know that what he says is true "without ceasing to be man." How can Haeckel, or, indeed, anyone else, adduce logical evidence to show that, during the eternity of time that is past, atoms always have had, and, during the eternity of time that is to come, always will have, say, the same weight and rate of vibration as they possess now? To quote again from Clifford: "A very simple consideration of the character of experiments would show him that they never can lead to results of such a kind; that being themselves only approximate and limited, they cannot give us knowledge which is exact and universal."

F. W. H. accuses me of pitting my *ipse dixit* against Hæckel's; but I think it is clear that I am merely testing Hæckel's statement by applying to it one of the conditions of belief.

Next as to the conceivability of atoms being conscious of their own motion, liking those atoms to which they are attracted, and disliking those from which they are repulsed. Du Bois Reymond, in an address at Leipzig, some time ago, expressed the following opinion: "It is absolutely and for ever inconceivable that a number of carbon, hydrogen, nitrogen, and oxygen atoms should be otherwise than indifferent as to their own position and motion, past, present, or future." Professor Reymond's opinion seems to me more reasonable than Hæckel's.

I am attracted to the earth by the force of gravity; am I therefore attracted to it because I "like" it? Manifestly not; I am not even conscious of being so attracted. But I am peculiarly conscious of the "attraction" which a beautiful woman possesses for me; indeed, were it not so, the "attraction" would lose all its sweetness.

F. W. H. says that "atoms, *even if unconsciously*, like each other." How, I would ask, can a thing be *unconsciously* "liked"?

The "fear of consequences" weighs just as little with me as it does with F. W. H.; with him, I look upon the truth as our "haven of rest." But then I do not regard the truth as something which we cannot know without ceasing to be men. Were I to accept such statements as those of Hæckel without considering what claim they had upon one's acceptance, I should probably be tossed about in a "haven of unrest." J. T. Routledge.

LETTERS RECEIVED AND SHORT ANSWERS.

H. J. Appleton. The Editor does not buy back numbers of Knowledge. You should advertise them. See notice (in capital letters) which concludes the heading of the "Correspondence Column."—E. L. G. Unfortunately, too purely theological for admission here.—Faciebat. Augite is a volcanic product, "a mineral," as you say; but then Trappean rock is merely an aggregation of minerals. The word "as," though, was a misprint for *in*.—F. W. Cleworth finds fault with Mr. Clodd's grammar in the sentences with which his article commences on p. 526 of our last volume; and further charges Mr. Clodd with intolerance of the failings of others. I cannot fail to be gratified with your P.S. though.—Dr. Lewins. Shall receive all the attention it merits.—Alfred Sargant. Received; but the whole thing is foreign to the purposes of a scientific journal.—T. P. Barkas, F.C.S. Put into plain English, your letter means that you have wholly failed to discover how the trick is done. "Scores of credible and ordinarily competent witnesses vouched for the genuineness of" Miss Florrie Cook's performance—until Sir George Sitwell and Herr von Buch found her out.—Constant Reader. If, as you state, a reward of £1,000 is offered for a correct imitation of the automata, and you can reproduce them, your course is obvious. Construct the figures, and formally claim the sum advertised. If you have really discovered the secret, you have your remedy in a Court of Law, in the event of the advertisers refusing to pay you the sum they offered.—Hernhurst. Mr. John Browning, of 63, Strand, London, would be the best man to apply to for a photograph of the Moon. They vary considerably both in size and price.—R. L. Mattra. Shall receive immediate attention.—C. E. P. says, with reference to the alleged new form of gas-burner described on p. 530, of Vol. VI., that it has been for some years in use in the Melbourne Observatory. It bears the date "September 28, 1868."—J. Murray. Indeed, I do not wish to be "so short"; but I do wish to goodness that you wouldn't be so long. It may (or may not) be true, as you say, that, "If science will not work from the expansion and contraction scale, and clearly despence with the attractive force, which has a left-handed sound, I fail to see how this or that can ever come to pass;" but I should be better able to judge of this if I had the slightest conception what it meant.—Jo Smith wants to know whether Dr. Allinson (letter 1554, p. 18) laid ice or fomentations on his back?—Dr. Foulerton sends an abstract of a paper read before the Geologists' Association, on Jan. 2, by Dr. Henry Hicks, on the Geology of the North-West Highlands, from which it will suffice to quote the admission of the Director-General and Surveyors of the Scotch Survey, that they find the "evidence altogether overwhelming against the upward succession which Murchison believed to exist," in the strata in the locality referred to.—F. W. Rudler. Received with thanks.—L. S. Please to say whether you wish for a work treating the subject mathematically or not.—C. & B. suggests that Mr. Proctor should definitely indicate his Island Home in Mars; since in these days of annexation, unless his flag has been hoisted on all the neighbouring islets, he may shortly have some unwelcome neighbours in that planet!—Corkonian. Newcomb's "Popular Astronomy," published by Macmillan's, is admirable, and is sold at a price rather less than your superior limit. If you like to spend a few shillings more, Chambers's "Handbook of Descriptive Astronomy" is a kind of encyclopædia of the subject, to which you may always turn for information (see p. ix. of advertisement sheet of our last number).—Gen. Thomson. I am ignorant of Mr. Morrell's address. See concluding paragraph (in capital letters) which heads the correspondence column.—E. Gulland. Delayed through being addressed to the Editor, instead of to the *Publishers*.—R. Wright. A precisely similar delay, from the same cause, has arisen in your case.—E. Smyth. See paragraph, Vol. VI., p. 473, which concludes the correspondence column.—F. W. H. If I understand Hæckel's esoteric hypothesis, he does attribute to atoms will differing in degree, though not in kind, from human volition. Whether, though, this can be in any sense held to be founded on observation and experiment, is open to the very gravest doubt. It really amounts to Hæckel *dixit*.—M.R.C.S. In replying to you last week on p. 39, in the penultimate line of column one, I seem to have inadvertently written the word "against" for "in favour of." Quite obviously the odds *against* the fourteen consecutive guesses are 16,384 to 1.—Romeike and Curtice. I care rather less than nothing what the *Shipping World* says.—Scorpio. The wheelwork would have to be altered as far as the hour-hand of your suggested dial is concerned, whereas by simply painting the XIII. over (or under) the I., the XIV. over the II., and so on, the existing train of wheels in any watch would do.—W. S. C. Lyell's "Antiquity of Man," or Joly's "Man before Metals," Lyell's "Students' Elements of Geology," and "Carpenter on the Microscope." Consult Mr. Browning, of 63, Strand, on the subject of Lantern Exhibition.—R. Whist. Why not? Neither side has the monopoly of a particular pack prior to the first deal.—W. Grandy, asks for a copy of the verses forwarded by "Scorpio," but I have destroyed them. Would "Scorpio" himself care to send them to Ringwood?—S. Smith & Son. Our advertising columns are open to you.—T. H. Garfit wants to know where he can obtain *The Anthropological Review* for Oct. 1868, and a copy of Carl Vogt's "Lectures on Man."—Jessie Young. Declined with thanks.—A. Payne. I have over and over again refused precisely similar requests, and regret that I can make no exception in your favour. Do you get copies of (say) the *Illustrated London News* gratis?—Arcturus. At Greenwich Observatory the astronomical day has commenced at *midnight* since January 1, but it begins at noon in all the volumes of the Nautical Almanac at present published.—Wm. Beck. Thanks, no. The subject is already in competent hands.—A. T. Angell, William Rogers. Received.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

AN IMPROVED FIRE-BLOWER.

FIRES that do not "draw" well are familiar enough among household worries. The means of surely making a really good fire at any time must be to many a desideratum, and in view of this, Mr. William Paitfield English, of 180, High-street, Hull, has just invented an improved fire-blower, which is stated to possess the advantage of being easily, quickly, and readily attached, and applied to any ordinary fire-grate with the view of creating a strong draught, and causing the fire to burn brighter and better. The patent consists of a metal or other frame of a convenient size, which is filled in with asbestos or other suitable material. The blower so made may be ornamented, or it may be made of a solid sheet of metal or other substance, ornamented or not. The blower is made to fit or cover the front part of the fireplace above the grate, and is held in position by suitable supports, a handle being fitted to the back.

SCHAEFFER'S PATENT TAP AND BUNG CLOSER.

THE use of cask beers is now so universal in well-ordered households that some improvement in the ordinary rather clumsy, and often very wasteful, method of tapping casks has long been due. To meet this want, Mr. Anton Jos. Schaeffer, of 9, Mincing-lane, London, E.C., has patented an ingenious arrangement whereby all trouble is saved, and any one can perfectly tap a cask as easily as they can open or shut a door. It is claimed for this system that it possesses the following important advantages:—It enables anyone to tap a cask without trouble or loss of liquid; also without disturbance of the same. It ensures the casks being kept sweet and clean, as, when the tap is removed, the cask is perforce hermetically sealed. It effects an entire saving of corks, and further protects the bung-hole, preventing the injury that part usually sustains, and the subsequent repairing that in most cases becomes necessary. It is of very simple construction, and strong, not liable to get out of repair, and the cost is so trifling that it needs but a trial to ensure its universal adoption. A single tap can be used for several casks, and when the tap is removed it forms a convenient safety lock, especially when fitted with the lid, which is recommended for casks intended for travelling.

THE IMPERIAL LINEN STRETCHER.

WITH most marking-ink, a contrivance is sold to stretch the object to be marked; but it is always more or less unsatisfactory, and there has long been a good opening for such an invention as the "Imperial" Linen Stretcher (Musgrave's patent), which is manufactured by Messrs. E. Wolff & Sons. The apparatus consists of a block of cedar wood conveniently shaped for holding the fabric to be marked, and attached to which is a stout wire loop worked upon pivots and fitting closely to the sides of the block. The wire has merely to be raised, the linen or fabric to be laid smoothly over the surface of the block under the wire, and the latter when lowered will firmly clamp the linen, thus presenting a smooth surface for marking. The marking-ink is contained in a reservoir within the block. This ink reservoir reaches, it is said, nearly to the end of the block, and contains the quantity of ink usually supplied in bottles sold for one shilling. The ink seems to be of an excellent quality, and, as the apparatus is all in one, there is an obvious convenience over the separate and imperfect round "stretcher" often sold with various kinds of inks.

STRAWFENA CIGARETTES.

CIGARETTE-SMOKING has enormously increased of late years, and it is alleged that to many mischief results from the practice. The most practicable remedy is an improved form of cigarette smoking, cool and deprived of any injurious characteristics. Messrs. Robinson & Barnsdale, cigar manufacturers, of Free Church-street, Derby-road, Nottingham, have with this aim patented what is known as the Strawfena Cigarette. This patent consists of a small clay disc, through which the smoke passes into a straw mouthpiece fitted to a paper coil, which can be elongated at pleasure. In this cigarette there is no waste, the essential properties of the tobacco cannot reach the smoker's mouth, and generally the Strawfena may be deemed to be a hygienic contrivance.

FIREPROOF FIXING-BLOCKS.

MOST persons know the difficulty there is in properly fastening joiners' work to walls, while the use of wood, when in chimney-breasts and close to flues, often results in fire. In order to overcome this difficulty, Mr. George Wright, of 3, Westminster-chambers, has introduced a material, recently described before the Society of Architects, which is stated to be safe and imperishable. The fixing-blocks are fireproof, as hard and everlasting as brick or stone, yet nails can be driven into them with the utmost facility. Being made about the same size as ordinary bricks, they are built into reveals of openings, jambs, &c., without the slightest extra labour or trouble to the bricklayer, and without destroying the bond of the work. When in position, the blocks at once form a fixing for the wood-linings, architraves, &c., and which become in reality fixed to the solid wall, dispensing entirely with the wood-joint pieces, strips, &c., which shrink, and frequently require wedging-up before a set of linings can be fixed. Driving plugs, and consequent injury to walls, is entirely obviated by using these fireproof blocks. They can also be safely inserted near fireplaces and flues, and for fixing bell-pulls upon chimney-breasts, without the slightest risk of taking fire—a great advantage over wood-plugs, which in these positions are a source of danger. Finally, these blocks may be beneficially introduced wherever it is necessary to nail or screw anything to brick, stone, or concrete walls, either in carpenters', bell-hangers', or gas-fitters' work; and they can be readily cut with a trowel.

CUPBOARD FASTENING.

EVERY housewife knows well what a nuisance most cupboard fastenings are, and how useless, too, they generally become in the end. In view of this well-known domestic inconvenience, Messrs. Brendon Brothers, of Collington, Cornwall, have invented a new cupboard fastening, which embodies a noticeable improvement on the ordinary "cupboard turn," simply by making a slot in the sunk portion of the face of the escutcheon for about one-third of its circumference. A stud attached to the knob runs in this slot, and thus prevents the blade of the fastener from falling below a horizontal line.

AN IMPROVED BILLIARD TABLE.

THE lovers of Billiards are so numerous that any real improvement in that popular game or its appliances is sure of a wide and prompt welcome. Mr. Eustace Bennett has, it appears, patented a method for readily transmitting billiard balls from a pocket of a billiard-table to another pocket of the same, without the trouble of removing the said balls from one part of the billiard-table to another part thereof, in the manner hitherto required. To effect this object the several pockets of the billiard table are made of strips (round or otherwise) of covered indiarubber, or other elastic material, with a band of india-rubber attached to the back thereof, and in each pocket there is formed an aperture at the bottom or side thereof, sufficiently large to allow an ordinary billiard ball to pass through. The three pockets on each side of the billiard-table are put into communication one with another, by means of a half tube made of metal, wood, gutta-percha, or other suitable material, lined with cloth, flannel, sheet india-rubber, or with curved wires fitted to the top, at a distance of about one inch apart, thereby forming a tube of sufficient diameter to admit easily a billiard ball of the ordinary size. The tubes are to be open where connected with the pockets, so as to be capable of receiving a billiard ball, and they are to extend in a line horizontal, or nearly so, from the top to the bottom pocket, on each side of the table, and to be supported at, or near the middle, by a pivot or axis fixed to the table. The tube on each side of the table is to be affixed to the pockets, so that their respective apertures are caused to meet; they are fastened together by making the ends of the strips and bands of the pockets pass through holes in the tubes, such strips and bands being secured on the other side. When the tube, or a pocket, is raised or lowered at or near either end of the table, the ball contained therein will travel along the tube and pass from one pocket to another as required, without the necessity of removing the balls.

RUSSIAN MECHANICAL INDUSTRY.—With the view of encouraging the manufacture of locomotives and railway rolling stock in Russia, the Russian Government has given the following sums in bounties or premiums during the last five years:—1880, 2,929,051 roubles; 1881, 2,039,515 roubles; 1882, 1,034,783 roubles; 1883, 748,487 roubles; and 1884, 1,950,600 roubles. The aggregate premiums for the five years amount, it will be seen, to 8,700,000 roubles.

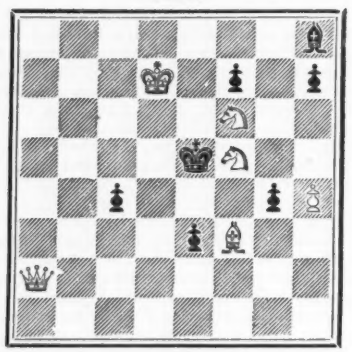
Our Chess Column.

By Mephisto.

PROBLEM No. 146.

By C. Planck.

Black.



White.

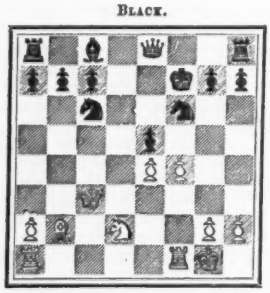
White to play and mate in three moves.

One amongst a number of games played at Bradford simultaneously :—

Evans.

White. Mr. Gunsberg.	Black. Mr. Onions.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to B4	B to B4
4. P to QKt4	B × P
5. P to QB3	B to B4
6. P to Q4	P × P
7. P × P	B to Kt3
8. Castles	Kt to R4 (*a*)
9. B × P (ch) (*b*)	K × B
10. Kt to K5 (ch)	K to B sq.
11. Q to R5 (*c*)	Q to K sq.
12. Q to B3 (ch)	Kt to B3
13. B to Kt2	P to Q3
14. Kt to Q2 (*d*)	B × P (*e*)
15. B × B	P × Kt
16. B to Kt2	K to B2 (*f*)
17. Q to B3	Kt to B3
18. P to B4	

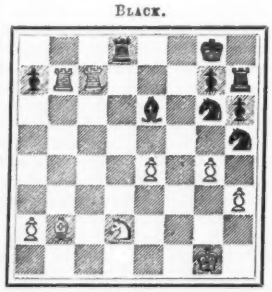
Black.



White.

18.	K to Kt sq.
19. P × P	Kt to KR4
20. B to R3	B to Q3 (*g*)
21. QR to Kt sq. (*h*)	Q to Q2
22. Q to B3	Q to K sq. (*i*)
23. R × P	Kt × P
24. Q to B3	Kt to Kt3
25. Q × P	Q to Q sq. (*j*)
26. R to B7	Q × Q
27. KR × Q	P to KR3
28. B to Kt2	R to R2
29. P to KR3	R to Q sq.
30. P to KKt4	

Black.



White.

30.	R × Kt (*k*)
31. R to Kt8 (ch)	Kt to B sq.
32. B to R3	K to R sq.
33. R × Kt (ch)	B to Kt sq.
34. P × Kt	P to Kt4
35. QR to B8	R to Kt2
36. B to Kt4	R to P8 (ch)
37. K to B2	K to R2
38. B to B3	R to B2 (ch)
39. R × R (ch)	B × R
40. R to R8 mate.	

NOTES.

(*a*) P to Q3 is the right move here.

(*b*) The position offers great inducement for this sacrifice.

(*c*) Played with the object of making Black play Q to K sq., in order to prevent his interposing the Q on B3, as of course a piece on that square can easily be attacked.

(*d*) A well-calculated attempt at development. Of course, if P × Kt, P × P.

(*e*) The text move apparently improves Black's position.

(*f*) K to Kt sq. at once would have been better.

(*g*) Black is willing to give up his Q for R and B, in addition to a piece he already has.

(*h*) Electing not to take the Q; on the whole, perhaps risky.

(*i*) P to KR3 seems to be the better move.

(*j*) R to B sq. would have been better.

(*k*) This move loses. Black ought to have played Kt (R) 4 to B5, with a defensible position.

Problem No. 144, by W. Grimshaw, p. 20.

Position.

White.—K. KKt7. R's. KKt sq., Q5. B. QB6. Kt. KR4. P's. KR3, 5, KB2, QB2.

Black.—K. K5. Q. QR3. Kt. QKt2. P's. QKt3, QB6, K7, KB5, KR3.

Solution.

1. R to KB sq. !	P × P (Q)
2. Kt to B3 ! !	Q to Kt7 (ch)
3. R to Kt5 (dis ch) mate	
2. if	K × Kt
3. R to Q2 (dis ch) mate	
1. or	Q to B5
2. P to B3 (ch)	K to K6
3. Kt to Kt2 (ch) mate	
1. or	P to B6
2. R to Kt sq.	Any
3. R to Kt4 (ch) mate	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

R. P. T.—Game received with thanks.

Correct solutions received: Problem 143, W. Parker. Problem 144, W. Furnival. Problem 145, W. Donna.

Uncle John.—Victor Wahltuck.

Donna, M. T. Horton.—If 1. R to Kt4 in No. 144, then Kt to Q6 and no mate in two is possible.

Peru seems slightly in advance of some other countries, for its Government has just arranged to have the principal cities lit by electricity. Coal is very costly in the Peruvian Republic, and Lima and Callao are the only places that have been lighted with gas, while all others have depended on kerosene lamps. In most of the cities the electricity will be generated by means of running water, and the expense will thereby be marvellously reduced.—*Electrical Review.*

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